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FITZGERALD (J. S.), RATCLIFFE (F. N.) & GAY (F. J.). **Trial Fumigations of Bulk Wheat with Methyl Bromide and "Cyanogas G."**—*J. Coun. sci. industr. Res. Aust.* **14** no. 2 pp. 97–110, 4 refs. Melbourne, 1941.

As a result of war conditions and the large wheat crop of 1939–40, the system of silos in the Australian States in which wheat is handled in bulk has had to be employed for the prolonged storage of grain, for which it was not intended, with consequent danger of serious infestation by insects. The only practical method of dealing with such infestations appears to be fumigation, though the Australian silos, most of which consist of open topped bins communicating freely with the space below the common roof, provide unsuitable conditions for it. All the fumigants commonly recommended for the treatment of stored wheat have to be imported or manufactured from imported materials, and their availability and toxicity (with related dosage), on which both the relative cost and the ease of handling depend, have to be considered, together with their suitability for treating the large masses of grain contained in cylindrical bins 60–70 ft. high and 36 ft. in diameter. Methyl bromide and Cyanogas G (crude commercial calcium cyanide in fine granular form), which reacts with atmospheric humidity to liberate approximately one-quarter of its weight of hydrocyanic acid gas, appeared to fulfil these conditions, and were therefore tested in New South Wales in 1940. A bin that had been filled a fortnight before with 50,000 bushels of wheat infested chiefly with *Rhizopertha dominica*, F., and containing fair numbers of the secondary grain pests, *Tribolium* and *Oryzaephilus* (*Silvanus*) [*surinamensis*, L.], but very small numbers of *Calandra* spp., was covered with a nearly air-tight lid, fumigated with 100 lb. methyl bromide, introduced at four points when the temperatures in the bin raged from 75 to 93°F., and left undisturbed for over 100 hours. The results were unsatisfactory, apparently because the lateral spread of the gas through the grain from the points of application was insufficient and the downward penetration was too rapid, the heavy gas accumulating at the bottom of the bin and leaking into the conveyer tunnel through the four delivery valves. Its toxicity was demonstrated by the kill of *R. dominica* in the hoppers at the base of the bin (80·5–99·7 per cent.), of *Rhizopertha*, *Tribolium*, and *Oryzaephilus* in the tunnel, where the gas must have remained for a time after escaping through the valves, and of all stages of *C. granaria*, L., introduced near the base of the bin in test cages (almost 100 per cent.).

Cyanogas G was applied to two bins approximately 6,500 bushels in capacity, 14 ft. 3 ins. in diameter and 60 ft. high; it was introduced at the rate of 11·5 lb. per 1,000 bushels, with twice this dosage for first- and last-run grain, into the stream of wheat, which was infested chiefly by *R. dominica*. One bin was left uncovered; the other was covered, but with no attempt at gas-proof sealing, and the grain in it levelled. Both were left undisturbed for more than ten days after fumigation. Though the dosage was little greater than that (10 lb.) recommended for closed bins, a complete kill was obtained of all stages of *C. granaria*, introduced about 12 ins. below the surface of the treated grain, in both bins, and no living individuals of *R. dominica* were found in either. It is pointed out, however, that further trials are necessary before it can be assumed that satisfactory control of *Calandra* would be obtained with the dosage employed in this test.

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GAY (F. J.). **Temperature Changes during the "Turning" of Bulk Wheat.**—*J. Coun. sci. industr. Res. Aust.* **14** no. 2 pp. 111–116, 2 figs., 1 ref. Melbourne, 1941.

The following is based on the author's introduction and summary. When wheat stored in silos in New South Wales shows signs of going out of condition owing to heating, which may or may not be associated with the presence of grain-infesting insects, the usual practice is to turn it by running it from one storage bin into another. In the investigation described, this process lowered the mean temperature of the grain from 88·7 to 86·5°F., but its most striking and important effect was to break up pockets showing dangerous extremes of temperature and so to produce a more even temperature in the mass. The air temperature during the turning was roughly the same as that of the coolest wheat.

GAY (F. J.). **Some Moisture Relations of Australian Wheats.**—*J. Coun. sci. industr. Res. Aust.* **14** no. 2 pp. 117–120, 2 graphs, 2 refs. Melbourne, 1941.

The following is based on the author's introduction and summary. The moisture content of stored wheat is an important factor in the development of grain insects, particularly *Calandra granaria*, L., and *C. oryzae*, L. Opinions vary as to the minimum moisture content that will allow these weevils to develop, but the limiting value seems to be close to 10 per cent., at any rate for *C. oryzae*, which is the more important species in Australia. Under normal conditions, much of the Australian wheat is harvested with a moisture content not greatly in excess of this figure. The moisture content of the wheat when it is in equilibrium with the relative humidities likely to be experienced in storage, used in conjunction with accurate meteorological data, should provide a basis for determining the suitability of any particular district for storage, the degree of suitability depending on the extent to which the mean relative humidity of the district corresponds with the relative humidity that is in equilibrium with the critical moisture content for weevil development. The moisture contents of some Australian wheats were, therefore, determined when in equilibrium with relative humidities between 20 and 70 per cent. at temperatures of 20–30°C. [68–86°F.]. Variety of wheat and temperature affected the equilibria slightly, but in general the wheats studied ranged from a percentage moisture content of approximately 7 at 20 per cent. relative humidity to approximately 13·5 at 70 per cent. Wheat in thin layers showed a quick response in its moisture content to changes of relative humidity in the atmosphere. This change in moisture content can be as much as 4 per cent. in four days. With exposure to the same difference in relative humidity, there is no significant difference in the rate of gain or loss of moisture content.

HARUKAWA (C.). **Heat as a Means of controlling Angoumois Grain-moth. II. Velocity of the Rise of Wheat Temperature during Heating.**—*Ber. Ōhara Inst.* **8** pt. 4 pp. 455–464, 6 figs., 5 refs. Kurashiki, 1941.

In the author's experiments on the effect of heat on *Sitotroga cerealella*, Ol., in stored wheat [*cf. R.A.E.*, A **23** 217], it was assumed

that the temperature of the grain quickly reached the temperature of the oven, but the tests carried out to verify this, described in this paper, gave somewhat different results. The tests were made on small quantities of grain of different moisture content in wire-gauze cylinders about 6 cm. high and 3 or 6 cm. in diameter, placed on cork in a constant-temperature oven. The temperature of the wheat was measured by a thermocouple combined with a Leeds-Northrup galvanometer.

The following is based on the author's summary. The rate at which the temperature of wheat rises is affected by the quantity and the moisture content of the wheat, and by the difference between the temperature to which the wheat is to be raised (prescribed temperature) and the temperature of the oven. When the smaller cylinder was filled to a depth of 3 cm. with wheat of a moisture content of 11 per cent., it took about 21 minutes for the wheat to reach 50°C. [122°F.] in an oven temperature of 60°C. [140°F.] and about 44 minutes for it to reach 60°C. in an oven temperature of 70°C. [158°F.]. When the prescribed and oven temperatures were 50 and 60°C., an increase in moisture content from 11 to 15 per cent. did not much affect the time required for heating, but when they were 60 and 70°C., this increase in moisture content markedly prolonged it. The rate at which the temperature of the wheat rose was not much affected by moisture content in the first stages of heating, but after about 50°C. was reached the rate decreased in the wheat with the greater amount of moisture. The quantity of wheat markedly affected the rise of temperature; thus, when the temperature of the oven was 75°C. [167°F.] it took about 20 minutes to heat the wheat with 11 per cent. moisture to 60°C. when the diameter and height of the column were both 3 cm., and about 85 minutes when they were 6 cm.

HARUKAWA (C.) & KUMASHIRO (S.). **Heat as a Means of controlling the Angoumois Grain-moth. III. Resistance to High Temperature of the Angoumois Grain-moth.**—*Ber. Ōhara Inst.* **8** pt. 4 pp. 465–476, 1 graph, 5 refs. Kurashiki, 1941.

In view of the slow rate at which the temperature of stored wheat rises in an oven [see preceding abstract], further investigations were carried out in 1934–35 on heat as a means of controlling larvae and pupae of *Sitotroga cerealella*, Ol., in stored wheat [*cf. R.A.E.*, A **23** 217]. Infested grains were placed at the bottom of small columns of wheat in wire-gauze cylinders, 3 cm. in diameter, and the experiments were divided into two series. In the first, the temperature of the oven was higher by 10°C. [18°F.] than the temperature to which the wheat was to be raised (prescribed temperature) and was lowered when the wheat reached the prescribed temperature. The cylinder was filled with grain to a height of 1·2 cm. The times required for the wheat to reach prescribed temperatures of 50 and 60°C. [122 and 140°F.] were 11–12 and 20–34 minutes, respectively, but prescribed temperatures of 70 and 80°C. [158 and 176°F.] were not reached within the recommended time limits (30 and 20 minutes, respectively). When the prescribed temperature was 60°C., 93 per cent. of the larvae were killed in 1 hour and 100 per cent. in 1½ hours. When it was 70°C., 73, 93 and 98 per cent. were killed by heating for 15, 20 and 30 minutes, and when it was 80°C., 38 and 100 per cent. were killed by heating for 10 and 15 minutes.

In the second series of experiments, the oven was kept at the prescribed temperature throughout the test, so that the rise in temperature of the wheat was slower than in the first series. The cylinder was filled to a height of 1·5 cm. On an average, 95, 150 and 240 minutes were required for the wheat to reach prescribed temperatures of 45, 50 and 55°C. [113, 122 and 131°F.], respectively. As it happened, the air temperature in the oven was higher by from 0·5 to 1·5°C. [0·9–2·7°F.] than the prescribed temperature ; had it been the same, the duration of heating would have been greatly prolonged. It was shown that the time required to bring the wheat to the temperature of the oven was about three times as long as that required to bring it to a temperature lower by less than 1°C. [1·8°F.]. The approximate percentages of the larvae killed when the wheat was heated in an oven at about the prescribed temperature were 20 in 20 hours at 45°C. or 6 hours at 50°C., 60 in 8 hours at 50°C., 93 in 3 hours and 98 in 4 hours at 55°C., and 87 in 1 hour and 100 in 1½ hours at 60°C.

RAHMAN (K. A.). **Parasites of the Insect Pests of Sugarcane in the Punjab.**—*Indian J. agric. Sci.* **11** pt. 1 pp. 119–128, 2 refs. Delhi, 1941.

Notes are given on the bionomics, hosts and local distribution of the parasites that attack insect pests of sugar-cane in the Punjab, especially the Pyralids, *Scirpophaga nivella*, F., *Diatraea* (*Argyria*) *sticticraspis*, Hmps., and *Chilo trypetes*, Bisset, and the Lophopid, *Pyrilla perpusilla*, Wlk. *Telenomus beneficiens*, Zehnt., which is a parasite of the eggs of *S. nivella*, is most active in April and in August–October, when it completes its life-cycle in 10–12 days and parasitises 5 and 45–68·5 per cent. of the host eggs, respectively, but is scarce during May–July, when the temperature in the shade is 117°F. and the relative humidity 14 per cent. Nothing is known of its activities during November–January, when its host is present only as a hibernating larva. Two unidentified species of *Trichogramma* have been bred from eggs of *D. sticticraspis*, *C. zonellus*, Swinh., *Sesamia uniformis*, Dudgn., and *Emmalocera depressella*, Swinh. They are active between March and October and most abundant in September–October, when they parasitise 90 per cent. of the eggs in some years. One species completes its life-cycle in the eggs of *D. sticticraspis* in about six days at 90–98°F. Brief notes are given on the distribution and period of activity of several parasites of the larvae, including *Elasmus zehntneri*, Ferrière, which is recorded from *Scirpophaga nivella* ; *Rhaconotus scirpophagae*, Wlkn., from *S. nivella*, *Emmalocera depressella* and *C. trypetes* ; *Glyptomorpha* (*Stenobracon*) *deesae*, Cam., from *Scirpophaga nivella*, *D. sticticraspis*, *C. trypetes*, *C. zonellus* and *E. depresssella* ; *Goryphus* sp. from *S. nivella* and *C. trypetes* ; *Chelonus* sp. from *A. nivella* and *E. depressella* ; and *Ascogaster* sp. from *E. depressella*.

The eggs of *Pyrilla perpusilla* are attacked by *Ooencyrtus papilionis*, Ashm., and *Tetrastichus pyrillae*, Crwf., which are widely distributed in the Punjab. They are most active during September–November, when they sometimes parasitise over 70 per cent. of the eggs, but are relatively inactive during April–June and January–March. Eggs exposed on the leaves are much more heavily parasitised than those hidden between the leaf-sheath and the cane stem, where parasitism never exceeds 5 per cent. Early in August 1935, 2,900 parasitised egg-clusters of *Pyrilla* were placed in a 2-acre block of sugar-cane ; the

percentage of eggs parasitised in this block increased from 2 to 55 in less than four weeks, whereas it increased from 2 to 9 in a control block nearby. The durations of the life-cycles of the two parasites at different seasons and the yearly and monthly fluctuations in the percentage parasitism by them are shown in tables. The life-cycle of *O. papilionis* varies from 10 days in August to 64 days in November–January, and the females live about 5 days during April–October and about 24 days during the cold weather. The highest number of eggs laid by a female in captivity was 30. The life-cycle of *T. pyrillae* varies from 11 days in April–May and September–October to 23 days in November–December.

Dryinus (*Lestrodryinus*) *pyrillae*, Kieff., which was recorded at all four observation centres, attacks the nymphs of *P. perpusilla*. The percentage parasitism during each month of the year, which did not exceed 3·5, and the duration of the life-cycle are shown in tables. The parasite is active throughout the year, except from January to the middle of March, when it is usually in the pupal stage, but is abundant only during September–November. The life-cycle varied from 37 days in April–May and August–October to 157 days in October–April. Parasitism is slight in first-instar nymphs and heaviest in nymphs in the third and fourth instars. *D. pyrillae* is itself parasitised by a species of *Cheiloneurus*, which is usually active between November and March. The Stylopid, *Pyrilloxenos compactus*, Pierce, which parasitises the nymphs and adults of *Pyrilla perpusilla*, but shows a decided preference for the latter, was first recorded in the Punjab in 1928, and has subsequently been found throughout the areas in which sugar-cane is grown. It has usually been scarce, but was abundant at one observation centre in 1934 and at another in 1935. It is active throughout the year, passing through about five generations, and the life-cycle of the male lasts about 6 weeks.

CLEARE (L. D.). **The Amazon Fly under Drought Conditions in British Guiana.**—*Trop. Agriculture* **18** no. 7 pp. 131–134, 5 refs. Trinidad, 1941.

There was a severe drought during 1939–40 in British Guiana, during which the rainfall over the nine months from August 1939 to May 1940 ranged from 12·75 to 18·38 inches in the localities examined, and averaged only 17·67 inches, or 31·1 per cent. of the mean for the same period in the previous 59 years. A survey of the status of the Amazon fly [*Metagonistylum minense*, Tns.] as a parasite of *Diatraea* on sugar-cane was undertaken in August 1940 to determine the effect on it of the prolonged dry period, and the results, which are shown in detail in tables, were compared with those of the survey made in 1937 [*cf. R.A.E.*, A **26** 491] ; the position had apparently remained unchanged in 1939 [*cf.* **29** 538]. It was found that parasitism of *D. saccharalis*, F., by *M. minense* was unaffected by the drought, and it is evident that under conditions in British Guiana, the fly can adapt itself to prolonged dry periods. Parasitism of *D. canella*, Hmps., occurred in one field.

STULTZ (H. T.) & PATTERSON (N. A.). **Some preliminary Experiments on the insecticidal Value of certain Plant Extracts, more particularly those of *Delphinium brownii* Rydberg.**—*Sci. Agric.* **21** no. 12 pp. 776–782, 1 ref. Ottawa, 1941.

The following is based on the authors' summary. Preliminary tests of the toxicity to mosquito larvae and larvae of *Leptinotarsa decemlineata*, Say, of seven different plant alkaloids or alkaloid mixtures,

which were compared with nicotine sulphate as a standard, indicated that the alkaloid of *Delphinium brownii* was the most promising for further study. The results of more extensive tests with the delphinium alkaloid indicate that as a contact insecticide it cannot be expected to excel nicotine sulphate, having proved distinctly inferior against many of the insects, particularly Aphids, on which it was so tested ; that it may be expected to prove more effective as a stomach poison and feeding repellent than nicotine sulphate, particularly if applied as a spray with an adhesive such as fish oil or adsorbed on activated carbon particles ; and that it has no apparent value as a fumigant. Water solutions of the delphinium alkaloid do not retain their toxicity on standing as long as those of nicotine sulphate. Some of the results also suggest that spray residues of the delphinium alkaloid do not retain their toxicity as long as those of nicotine sulphate, but this defect might be overcome, to some extent at least, by the adsorption of the alkaloid on activated carbon.

MEDLER (J. T.). **The Nature of Injury to Alfalfa caused by** *Empoasca fabae* **(Harris).**—*Ann. ent. Soc. Amer.* **34** no. 2 pp. 439–450, 2 pls., 3 refs. Columbus, Ohio, 1941.

Empoasca fabae, Harr., is capable of causing serious injury to a great number of plants, many of which are of economic importance, and no other Jassid known in the United States causes such widespread destruction. To determine the nature of the injury, terminal leaflets of lucerne were exposed for three days to the feeding of single individuals of *E. fabae*, *Aceratagallia sanguinolenta*, Prov., and *Macrosteles divisus*, Uhl. From a histological study of the feeding punctures, the author concludes that *A. sanguinolenta* and *M. divisus* cause no apparent internal injurious effect on lucerne leaflets ; the sheath that is secreted appears to initiate no physiological changes in cells surrounding it, and there are no observable cytoplasmic or nuclear changes that show abnormalities resulting from deposit of this foreign material in the plant tissues. The nature of the injury by *E. fabae*, however, is unique, and is due to a combination of the insect's feeding habit in vascular tissue and the action of a specific compound injected during its feeding process. This secretion causes hypertrophy in affected cells, and its effect is first characterised by nuclear enlargement and prominent safranin-stained nucleoli. It is conceivable that the hypertrophied cells cause an interruption of translocation processes that initiate secondary external symptoms of chlorosis or reddening in lucerne leaves.

MORRILL jr. (A. W.) & LACROIX (D. S.). **Insect Investigations during 1940.**—*Bull. Conn. agric. Exp. Sta.* no. 444 pp. 278–285, 3 figs. New Haven, Conn., 1941.

Work on insect pests of tobacco in the Connecticut River Valley in 1940 included further experiments on the simultaneous control of *Epitrix cucumeris*, Harr., and *Frankliniella fusca*, Hinds, on both shade- and sun-grown tobacco, and on the use of naphthalene as a soil fumigant against the wireworm, *Pheletes ectypus*, Say (*Limonius agonus*, Say), all of which confirmed the results obtained in 1939

[*cf. R.A.E.*, A **30** 39, 40]. The naphthalene was applied on 13th June instead of 1st May, but its effectiveness was again decreased by the persistence of low temperatures for some weeks afterwards. The usual insect pests of tobacco did less damage than for a number of years; most of them appeared late, and some were not present in appreciable numbers. Large numbers of *Popillia japonica*, Newm., were again observed feeding on tobacco [*cf. loc. cit.*] in a field to which they had probably migrated as a result of the mowing of an adjoining hay field in which there was much jointweed (*Polygonum pennsylvanicum*), one of their preferred food-plants. As in the previous year, the injury was confined to the tops of the tobacco plants and was very moderate considering the large numbers of beetles present.

Knowlton (G. F.) & Janes (R. L.). **Control of Strawberry Root-infesting Weevils.**—*Proc. Utah Acad. Sci.* **18** pp. 23–29, 3 figs., 11 refs. Provo, Utah, 1941.

There are three species of *Otiorrhynchus* (*Brachyrrhinus*) of which the larvae feed on the roots of strawberry in Utah; *O.* (*B.*) *ovatus*, L., is the most common and widespread, *O.* (*B.*) *rugosostriatus*, Goeze, has caused serious damage in many localities, and *O.* (*B.*) *sulcatus*, F., which has apparently been introduced into the State during recent years, caused damage in one county in 1939 and 1940. All these weevils have one generation a year in Utah, and no males have been found. Both larvae that are more than half grown and adults in protected situations survive the winter. As the newly-emerged adults feed for about 10–14 days before ovipositing, control can be obtained by poison baits applied in the preoviposition period. Emergence continues for about 4 weeks, with a peak in June, and the oviposition period may last into September. The first application of bait should be made about 12–14 days after the first adults leave the ground, and a second is usually necessary two weeks after the first to destroy weevils that survive or emerge later. Baiting should not be postponed until after the completion of harvest, or eggs will have been laid. *O. ovatus* usually emerged one or more days before *O. rugosostriatus* in the same fields. Experiments against these two weevils, carried out in 1939 and 1940, are described. The baits used contained 5 lb. sodium fluosilicate, sodium fluoride or calcium arsenate mixed with 50 lb. ground dried apples, raisins or prunes, 45 lb. bran and 5–6 U.S. quarts water or with 100 lb. bran, 6·5 lb. molasses and 5 U.S. gals. water. A teaspoonful of the bait was placed in the crown of each plant or among groups of plants at intervals of 6–8 ins., approximately 100 lb. being used per acre. In the tests in which the results were analysed statistically, all baits gave good control, sodium fluosilicate was markedly better than the other poisons, and there was no significant difference in efficiency between baits containing the same poison but different carriers.

In a supplement, Knowlton states that substantial control of *Otiorrhynchus* was obtained on a number of farms in Utah in 1940 with grasshopper bait, consisting of 400 lb. wheat bran, 2 U.S. gals. sodium arsenite (containing the equivalent of 4 lb. white arsenic per U.S. gal.) and 35–45 U.S. gals. water, applied in the same manner as the other baits. If satisfactory, this bait would be less expensive and easier to prepare than the usual *Otiorrhynchus* baits.

WHITTEN (R. R.). **The internal Application of Chemicals to kill Elm Trees and prevent Bark-beetle Attack.**—*Circ. U.S. Dep. Agric.* no. 605, 11 pp., 5 refs. Washington, D.C., 1941.

One of the most difficult problems in the programme for the eradication of Dutch elm disease in the United States has been to find a method of effectively destroying the many wild elm trees that are possible reservoirs of the causal fungus, *Ophiostoma* (*Ceratostomella*) *ulmi*. Cutting and burning the trees does not prevent their regrowth, but investigations in 1936–38 showed that it is possible to kill them, without rendering them liable to attack by Scolytids, by introducing certain chemicals into the sap stream. The materials most commonly used were saturated solutions of copper sulphate or sodium arsenite in water and dry granular copper sulphate, used at dosages of 15–120 gm. dry salt per inch diameter of the tree. They were applied by putting them into watertight bands fastened round the trunk where the bark had been cut through [*cf. R.A.E.*, A **28** 336]. Treated trees were examined later to determine the rate and degree of kill, and the extent to which the trees were attacked by bark-beetles ; the results are shown in tables. The stumps of trees killed with the solutions did not grow, but those treated with dry copper sulphate sprouted vigorously ; and treatment was much more effective when the trees were in leaf than when they were dormant. In tests with 34 other chemicals, it was found that solutions of ammonium bifluoride, copper nitrate, copper chloride and zinc chloride in water were effective in killing elm trees and preventing sprouting from the roots, while elm wood from trees treated with zinc chloride, which was the only one to be applied to large numbers of trees under field conditions, showed a certain amount of local inhibition to the growth of *O. ulmi*. The greater number of approximately 5,000 elm trees treated in 1938 were 3–12 inches in diameter, and only 11 were over 20 inches. Materially increased dosages per inch diameter were used on these larger trees, and only one of ten examined later was found to be badly infested.

WINGO (C. W.). **The Oriental Fruit Moth in Missouri.**—*Bull. Mo agric. Exp. Sta.* no. 424, 15 pp., 6 figs. Columbia, Mo., 1941.

Cydia (*Grapholitha*) *molesta*, Busck, which was first recorded in Missouri in 1930, is now established throughout the State, but is a major pest of peach only in the east and south ; it was not observed in the north-west until 1935, but bait-trap records for 1936–39 indicate that it is increasing in numbers there. Serious injury has also been recorded on apricot, quince and apple. A brief account of the bionomics is given, and graphs show the periods during which adults of the different generations were active in the orchards in 1938, 1939 and 1940 and the relation of the occurrence of third-generation adults to the harvest time of Elberta peaches in these years and in 1937. In southern Missouri, there are five generations a year, but in the north there are probably only four, with a partial fifth the size of which is dependent on autumn weather conditions.

Twelve indigenous parasites of the larvae have been recorded in Missouri. They are the Tachinids, *Lixophaga variabilis*, Aldr., and *Anachaetopsis tortricis*, Coq., the Braconids, *Microdus* (*Bassus*) *annulipes*, Cress., *Macrocentrus delicatus*, Cress., *M. instabilis*, Mues., *M. pallisteri*, DeGant, *Microgaster ecdytolophae*, Mues., *Eubadizon pleuralis*,

Cress., and *Apanteles* sp., and the Ichneumonids, *Cremastus forbesi*, Weed, *C. minor*, Cushm., and *Glypta rufiscutellaris*, Cress. The parasites that have been most abundant in recent years are *Macrocentrus delicatus*, the introduced *M. ancylivorus*, Rohw., which is well established in the south, *E. pleuralis*, and *G. rufiscutellaris*; attempts to establish *Angitia* (*Dioctes*) *molestae*, Uch., were unsuccessful. *Trichogramma minutum*, Riley, has been observed parasitising eggs of the codling moth [*Cydia pomonella*, L.] in Missouri, but not those of *C. molesta*.

Experiments on dusting and spraying schedules for use in Missouri were carried out in peach orchards during 1937–40, and the results are shown in tables. Recommendations based on them comprise four applications at intervals of 5–7 days, starting 30 days before harvest, of a dust of 60 lb. dusting sulphur, 20 lb. talc, 15 lb. dusting lime and 5 lb. lubricating oil (viscosity 80–110), or a spray of 6–8 pints summer oil and 1 pint nicotine sulphate in 100 gals. water; in 1938 (the only year in which both schedules were used) the dust gave 97·6 per cent. uninfested fruit and the spray (containing 8 pints oil) gave 98·1 per cent., compared with 81·4 per cent. in the controls. Proprietary fixed nicotine sprays are also recommended. Where heavy brown rot infections appear on trees receiving the oil-nicotine spray, the treatment should be discontinued, and sulphur applied to control the brown rot 4–5 days after the last application of the spray. No satisfactory dust or spray has been found for protecting late peaches, and the planting of varieties that ripen later than mid-August should be avoided.

Supplementary control measures include spring cultivation and the removal or destruction of débris, the destruction of infested fruit, the destruction soon after harvest of mummified fruit, and screening the packing sheds and keeping them closed during April, when adults of the overwintered generation are emerging. Treatments with paradichlorobenzene [*R.A.E.*, A **27** 526] against the peach tree borer [*Aegeria exitiosa*, Say] destroy many larvae of *C. molesta* in cocoons round the base of the tree and on the part of the trunk enclosed in the mound.

HARRINGTON (C. D.). **Influence of Aphid Resistance in Peas upon Aphid Development, Reproduction, and Longevity.**—*J. agric. Res.* **62** no. 8 pp. 461–466, 1 fig., 3 refs. Washington, D.C., 1941.

The following is based on the author's summary and conclusions. Two experiments were carried out under greenhouse conditions to determine the influence of resistance in peas to *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) on the development, reproduction and longevity of the Aphid. In both experiments, 60 Aphids were confined individually on 30 plants of a partly resistant variety and 30 of a susceptible variety. From analysis of the data obtained, it is concluded that the rate of development, rate of reproduction and total life span are reduced by 3·1, 12·5 and 20 per cent., respectively, on the more resistant variety; that the cumulative effect of resistance acting on Aphid populations throughout the pea-growing season may explain why resistant varieties are often able to produce a crop when susceptible strains are destroyed; and that data on relative rates of Aphid reproduction appear to offer a better possibility for measuring the comparative resistance of pea varieties than data on rates of development or length of life.

LARSON (R. H.) & WALKER (J. C.). **Ring Necrosis of Cabbage.**—*J. agric. Res.* **62** no. 8 pp. 475–491, 12 figs., 10 refs. Washington, D.C., 1941.

In 1937, many mature plants in a plot of cabbage in Wisconsin infected with a mosaic disease described previously [*R.A.E.*, A **28** 321] showed necrotic ring lesions, particularly on the outer head leaves; they were caused by a distinct virus, which was found to produce various degrees of chlorosis and necrosis on cabbage. The disease is termed ring necrosis of cabbage; its symptoms in different plants and the properties distinguishing the virus from other viruses of crucifers are described. It was readily transmitted by mechanical inoculation to all the crucifers tested, including some 25 species and subspecies or botanical varieties, a list of which is given, and certain non-cruciferous plants, including sugar-beet, Swiss chard, spinach, tobacco and other species of *Nicotiana*, *Petunia*, *Zinnia* and *Calendula*. In tests with *Myzus persicae*, Sulz., and *Brevicoryne brassicae*, L., both Aphids transmitted the virus readily to cabbage seedlings.

GIDDINGS (N. J.). **Some Factors influencing Curly-top-virus Concentration in Sugar Beets.** (Abstract.)—*Phytopathology* **32** no. 1 p. 6. Lancaster, Pa., 1942.

The best method of determining the concentration of curly-top virus [*Chlorogenus eutetticola* of Holmes] in sugar-beet is to feed virus-free leafhoppers [*Eutettix tenellus*, Baker] for a short time on the plants or extracts to be tested, transfer them to healthy young sugar-beets and determine the relative percentage of plants that become infected. Feeding periods of 3–9 hours on the plants were found most satisfactory. The shorter periods gave best results at about 110°F. Highly resistant beets had a significantly lower virus concentration than susceptible ones. The less virulent strains of the virus were present in significantly lower concentrations than the more virulent strains. Beets infected for several months showed significantly lower virus concentration than those infected for a few weeks, but it is possible that soil nitrogen may be a factor in this case.

GOODWIN (M. W.), HOPPERSTEAD (S. L.) & KADOW (K. J.). **Compatibility of diluent Dusting Materials with Copper Fungicides with and without Calcium Arsenate.** (Abstract.)—*Phytopathology* **32** no. 1 p. 6. Lancaster, Pa., 1942.

Samples of dusts, both with and without calcium arsenate, were prepared, using 48 different diluent materials, each with red cuprous oxide, tribasic copper sulphate and copper oxychloride. These were analysed for pH, water-soluble Cu, and water-soluble As_2O_5. It was apparent that the pH of the mixture is a good indication of the amount of water-soluble copper liberated. There was a good correlation between pH and water-soluble copper, with the danger point about pH 5·5. Below this pH, amounts of water-soluble copper were liberated that could be injurious to plants. When calcium arsenate was present, no water-soluble copper was liberated, because of the presence of free calcium, which, in every case tested, kept the pH of the mixture well above 5·5. Such was not true in the case of water-soluble arsenic. Different calcium arsenates produced varying results. As a general

rule, when dealing with the same calcium arsenate, the lower the pH, the higher the water-soluble arsenic. Above pH 10·0, very little water-soluble arsenic was liberated. However, the character of the arsenate itself, rather than either the diluent or copper used, will determine the safety of the dust mixture. Limited studies with certain organic materials added to dust mixtures indicate that the above generalisations do not always hold.

HARRAR (J. G.) & MCKELVEY jr. (J. J.). **Biological Control of the Mealy Bug** (*Pseudococcus* spp.). (Abstract.)—*Phytopathology* **32** no. 1 p. 7. Lancaster, Pa., 1942.

The name *Endosclerotium pseudococcia* is proposed for a fungus that has been previously recorded as a virulent, specific parasite of the mealybug [*Pseudococcus comstocki*, Kuw., in Virginia (*cf. R.A.E.*, A **29** 500)]. Laboratory experiments under controlled conditions of temperature and moisture were entirely successful in the destruction of the mealybug population, and equal success was obtained in greenhouses. Observations in apple orchards indicate possible high mortality of mealybugs from natural infection and that the artificial addition of inoculum may be beneficial. Under favourable conditions, the fungus will rapidly destroy mealybugs in all stages, except the egg, while under unfavourable conditions for growth, it produces highly resistant sclerotia that may remain viable for several months.

HEUBERGER (J. W.). **Improved Control of** *Alternaria solani* **(Early Blight) on Tomatoes by controlling Flea Beetles.** (Abstract.)—*Phytopathology* **32** no. 1 p. 8. Lancaster, Pa., 1942.

In an experiment carried out in view of a recent report that derris reduces the fungicidal effectiveness of copper compounds, six applications of dusts or sprays of several copper compounds with and without derris were made to tomatos between 30th June and 21st August to ascertain their effectiveness against early blight (*Alternaria solani*). Flea-beetles were abundant in June and July, but had disappeared by 1st August. Observations on 28th July and 8th August showed that the plots treated with the fungicides alone had more beetle-feeding punctures, more blight lesions and much more defoliation than those treated with derris. The control of the beetles by the derris had increased the control of the fungus by reducing the dissemination of the spores and the number of feeding punctures, which serve as foci of infection. The derris plots still had less defoliation on 8th September, though the beetles had disappeared more than five weeks before.

Effective control of blight where beetles are present early should be achieved by applications of copper and derris while the beetles are present followed by copper alone after they have disappeared.

HEWITT (W. B.), FRAZIER (N. W.) & HOUSTON (B. R.). **Transmission of Pierce's Disease of Grapevines with a Leaf Hopper.** (Abstract.)—*Phytopathology* **32** no. 1 p. 8. Lancaster, Pa., 1942.

The natural spread of Pierce's disease of grape vines [in California] indicates an insect vector. In 1939, 54 species of insects collected from vineyards, lucerne and natural cover were tested in a field plot as possible vectors, and 10 of the 94 vines upon which one or more species

of insects were caged developed the disease, as compared with only 1 of 215 control plants. In 1940, 60 species of insects were similarly tested. Of 21 and 19 plants caged with Jassids of the genera *Draeculacephala* and *Carneocephala*, respectively, six and three became infected, while only six of 506 control plants developed the disease. *Draeculacephala* was further tested in 1941 under controlled conditions. At the time of writing, nine vines showed leaf scorching and cane immaturity, which are typical autumn symptoms of the disease. Field observations showed a close correlation between the incidence of the disease and that of dwarf disease of lucerne. Leafhoppers that transmitted Pierce's disease in 1940, though fed on diseased grapes, had been taken from lucerne fields known to be affected by dwarf. In the tests in 1941, the leafhoppers that apparently transmitted the virus had been fed on lucerne infected with dwarf.

HOUSTON (B. R.), FRAZIER (N. W.) & HEWITT (W. B.). **Leaf-hopper Transmission of the Alfalfa Dwarf Virus.** (Abstract.)—*Phytopathology* **32** no. 1 p. 10. Lancaster, Pa., 1942.

Dwarf disease of lucerne has recently been found prevalent in the southern portion of the San Joaquin Valley in California, where it is now an important factor in the thinning of lucerne stands. In 1940, various species of insects taken from fields in which the disease occurred were caged with healthy plants, 63 per cent. of which developed the disease. Transmission tests with individual species of phytophagous insects from a field attacked by dwarf showed that transmission was effected by a species of *Draeculacephala*. A later trial with 100 individuals of this Jassid caged on diseased plants and subsequently transferred to 30 healthy ones resulted in 93 per cent. infection. The virus was transmitted from these diseased plants to healthy ones by grafting. Nine transmissions were later obtained with leafhoppers of the genus *Carneocephala*. In the summer of 1941, investigations involving several species of insects and several hundred lucerne plants were begun. At the time of writing, 19 transmissions of the disease had been obtained with leafhoppers of the genus *Draeculacephala*, and all the control plants remained healthy.

IVANOFF (S. S.). **Breeding Cantaloupes for Resistance to Downy Mildew and other Diseases and Pests.** (Abstract.)—*Phytopathology* **32** no. 1 p. 10. Lancaster, Pa., 1942.

Strains of cantaloupe melons have been obtained by cross-breeding that show satisfactory shipping qualities, combined with varied resistance to mildews, *Aphis gossypii*, Glov., and species of *Diaphania*, the larvae of which injure the leaves.

HANSON (E. W.) & MILLIRON (H. E.). **The Relation of certain Weevils to Root Rot and Basal Stem Rot of Cereals and Grasses.** (Abstract.) —*Phytopathology* **32** no. 1 p. 22. Lancaster, Pa., 1942.

Several species of weevils infest graminaceous plants and are important in the development of root rot and basal stem rot of cereals and grasses in the northern Great Plains region of the United States [*cf. R.A.E.*, A **30** 56]. Of these, *Sphenophorus* (*Calendra*) *parvulus*, Gylh., is widely distributed and attacks wheat, timothy [*Phleum pratense*],

blue grass [*Poa*] and crested wheatgrass [*Agropyrum cristatum*]. The injury is mostly confined to the lower internodes and is associated with severe rotting. The larvae apparently facilitate the dissemination of the rot-inducing organisms by their feeding and movement within the internodes, and the resulting frass is an excellent medium for the rapid increase of microorganisms.

Baker (K. F.) & Tompkins (C. M.). **A Virosis-like Injury of Snapdragon caused by Feeding of the Peach Aphid.**—*Phytopathology* **32** no. 1 pp. 93–95, 1 fig. Lancaster, Pa., 1942.

Injury to the terminal growth of snapdragons (*Antirrhinum* spp. and *Linaria*) under glass and in a protected situation out of doors was observed in California in 1940 and 1941. It was found to be caused by the feeding of *Myzus persicae*, Sulz., and probably resulted from some toxic secretion of the Aphid. *M. persicae* builds up large populations when caged on snapdragon, but has not been seen to do so on unprotected plants. Injured infested plants recovered when planted in the field in southern California.

Buchanan (W. D.) & May (C.). **Technique for artificially feeding** *Scolytus multistriatus* **and** *Saperda tridentata* **Spores of** *Ceratostomella ulmi* **and other Substances.**—*Phytopathology* **32** no. 1 pp. 95–97, 1 fig., 4 refs. Lancaster, Pa., 1942.

A description is given of a feeding technique evolved to facilitate studies of the relations between *Scolytus multistriatus*, Marsh., and *Ophiostoma* (*Ceratostomella*) *ulmi* [the fungus that causes Dutch elm disease] under conditions precluding external transfer of the fungus from the mouth parts to the posterior portion of the body and the faeces. It consists in fixing the legs of the beetle to the end of an upright match-stick by means of cellulose glue and allowing its head to enter a horizontal glass tube containing the feeding substances. Air currents and dust were kept from the apparatus by a celluloid cover. Beetles freely ingested food for as long as 15 days, and water and other substances for several days, while mounted on the match-sticks. In other experiments, predetermined small quantities of spore suspensions were injected directly into the mouths of the beetles. Ground bark similar to that on which the beetles fed was found in all parts of the gut and in faecal pellets voided by the beetles. Adults of *S. sulcatus*, Lec., and *Eutetrapha* (*Saperda*) *tridentata*, Ol., were also successfully fed by this method.

Abbott (E. V.) & Ingram (J. W.). **Transmission of Chlorotic Streak of Sugar Cane by the Leaf Hopper** *Draeculacephala portola*.—*Phytopathology* **32** no. 1 pp. 99–100. Lancaster, Pa., 1942.

Experiments on insect transmission of the virus [*Marmor quartum* of Holmes] that causes chlorotic streak of sugar-cane, which was first observed in 1928 in Java, were carried out in Louisiana in 1941 in an insect-proof greenhouse. The insect used was *Draeculacephala portola*, Ball. In some cases, the leafhoppers were confined with a number of diseased and healthy plants together in cages, about 5 leafhoppers being used per healthy plant. In others, leafhoppers that fed for 2–4 weeks on diseased plants were then confined with healthy plants only. After the feeding period was over, the healthy plants were freed from

insects and kept under observation. Of 490 exposed to leafhoppers in March–May, 25 had developed typical leaf symptoms of chlorotic streak by 1st September. Of these, 20 were from cages containing both diseased and healthy plants and 5 from those in which the healthy plants had been exposed to leafhoppers previously fed on diseased ones. Healthy plants grown near diseased ones free from leafhoppers did not contract the disease.

It is stated in a footnote that *D. portola* has been erroneously identified on sugar-cane in the Gulf States as *D. mollipes*, Say [*cf. R.A.E.*, A **28** 248, etc.]. The true *D. mollipes* appears to occur chiefly in the north-eastern United States and is not known as a pest of sugar-cane in Florida or Louisiana. *D. portola* is usually abundant on sugar-cane in Louisiana; the genus has been recorded in Hawaii, Porto Rico, Colombia and Louisiana, where the disease apparently spreads under natural conditions, but not in Java.

Billeš (D. J.). **Pollination of *Theobroma cacao* L. in Trinidad, B.W.I.**— *Trop. Agriculture* **18** no. 8 pp. 151–156, 3 figs., 12 refs. Trinidad, 1941.

In view of the lack of information on the pollination of cacao flowers and the practical importance of this problem, investigations to determine the agent that effects pollination were carried out in Trinidad, and are described and discussed in this paper, which also contains a brief review of the literature [*R.A.E.*, A **13** 611; **14** 18]. Wind and water were both shown to be ineffective, and unaided self-pollination is regarded as impossible. Since the percentage of flowers that is pollinated is low, pollination was thought to be effected either by a common but inefficient insect agent, or by an efficient but uncommon one. In a survey of insects that visit cacao flowers made on four estates in 1939–40 by A. M. Adamson and E. McC. Callan, less than 30 species was collected, of which the thrips, *Frankliniella parvula*, Hood, and the Aphid, *Toxoptera aurantii*, Boy., were the most common. Experiments in which adhesive bands were applied to the branches confirmed results obtained by previous workers indicating that flying insects are responsible for cross-pollination; in addition, evidence was obtained that self-compatible varieties are also pollinated to some extent by crawling insects. Most of the insects collected at flowers did not enter them, but *F. parvula*, a Ceratopogonid (*Forcipomyia* sp.) and young Aphids frequently entered the flowers and carried pollen; adult Aphids rarely did so. Estimates from September 1940 to April 1941 of the percentages of flowers to be pollinated showed that they were highest at the beginning of September and at the beginning of January, and these peaks coincided with very high populations of thrips and increased abundance of *Forcipomyia*, respectively. They were higher if the flowers contained thrips than if they did not, but the figures for Aphid-inhabited flowers were variable, and as Aphids often did not occur in flowers for long periods, they are not considered to be of great importance as pollinators. Two immature Aphids, a nymph of the Membracid, *Cymbomorpha* sp., and an adult of another Membracid, *Horiola picta*, F., were observed to effect pollination, and pollen masses that were later found to be deposited by females of *Forcipomyia* sp. were often observed in insect-free flowers; pollination by thrips was not seen, but a pollen mass containing a thrips seta was found in a thrips-inhabited flower.

Forcipomyia, which was the only insect observed to carry pollen from flower to flower and tree to tree, is rare, but has been collected from many estates in Trinidad. The adults are present only during the wet season from July to January, and this is the only period during which self-incompatible trees set fruit. The process of pollen transference by the females, which constantly enter and move about in the flowers, is described. *Frankliniella parvula* occurs on the flowers and flush leaves of cacao and the flowers of coffee, banana and weeds in cacao plantations ; it feeds on the flowers and flush leaves of cacao and other plants. In the laboratory, eggs were deposited at night in small cuts in the lower epidermis of the flush leaves. The larvae are very active and probably thereby escape attack by the introduced Eulophid, *Dasyscapus parvipennis*, Gah. [*cf.* **25** 424]. The mature larvae entered cracks in soil when they had the opportunity. The egg, larval, prepupal and pupal stages lasted 4, 6, 1½ and 2 days, respectively. The population in the flowers fluctuates considerably during the year, and these fluctuations are correlated with flushing and flowering intensity. The degree of pollination by *Forcipomyia* sp. varied considerably from branch to branch and from tree to tree ; in large samples it seldom exceeded 50 per cent. of the total pollination, but its relative importance is greater than is indicated by this proportion.

Insect Pests.—*Agric. Gaz. N.S.W.* **52** pt. 6 pp. 321–325, 4 figs. Sydney, 1941.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **30** 156] includes notes on winter control measures against certain pests of *Citrus*. *Prontaspis citri*, Comst., *Eriophyes* sp., and to some extent *Lepidosaphes beckii*, Newm., can be controlled by a winter spray of 2–3 gals. lime-sulphur having a polysulphide sulphur content of at least 20 per cent. in 30 gals. water applied over the whole tree, but this spray is not effective against *Ceroplastes destructor*, Newst., *Aonidiella aurantii*, Mask., or *Saissetia oleae*, Bern. The addition of a spreader is advised when spraying fruit and foliage. When trees are heavily infested with *A. aurantii*, or lemons and Valencia oranges are to be held late in the season, fumigation [with hydrocyanic acid gas] during the winter limits infestation until well into the summer. If fumigation in winter is followed in late summer by a further fumigation or a thorough oil spray, heavy infestations may be satisfactorily controlled and a very large proportion of clean fruit harvested in the following winter. Fumigation can be carried out safely at any time during the winter when the trees have hardened off right up to the stage of full-bloom, and higher dosages can be used.

Severe infestation of the leaves of silver beet by larvae of *Hymenia recurvalis*, F., was reported from several market garden areas in 1941. This Pyralid has also been recorded in New South Wales on *Amarantus* sp., *Chenopodium* sp., *Portulaca oleracea*, common beet, cotton, maize, and saltbush [*Atriplex*], but usually causes little damage to cultivated crops. Notes on its bionomics in Bermuda [*cf.* **22** 253] are quoted. Laboratory tests indicated that weekly applications of a dust of 1 lb. derris and 7 lb. kaolin or talc at the rate of 50 lb. per acre when the plants are dry would be effective against the larvae. The dust should be directed on to the lower surfaces of the leaves and into the hearts of the plants ; the pulling and destruction of the older

leaves before treatment would render dusting more effective. A dust of pyrethrum and talc (1 : 2) was not superior to derris and was more expensive. Lead arsenate should not be used, as plants carrying arsenical residues cannot be marketed. The Lycaenid, *Zizera* (*Zizeeria*) *labradus*, Godt., although the most abundant insect on lucerne, is only a very minor pest of that crop. The larvae occasionally destroy the pods and flowers and have also been found feeding on clover, French beans and peas. They are parasitised by at least one Chalcidoid.

Diadoxus erythrurus, White, infests Cypress pines (*Callitris* and *Cupressus*), and although injured and sickly trees appear to be more susceptible, trees that are quite healthy are also attacked. Adults of this Buprestid occasionally emerge from the timber after this has been used for floor coverings, but no reinfestation occurs. There is one generation a year. The eggs are laid in the bark, and the larvae feed on the inner surface of the bark next to the sapwood. When fully fed, the larva burrows in the sapwood and pupates ; the adults emerge from November to the end of January.

GADD (C. H.). **The Life-history of the Shot-hole Borer of Tea.**— *Tea Quart.* **14** pt. 1 pp. 5–22, 2 graphs, 10 refs. Talawakelle, 1941.

Direct observations on the early stages of *Xyleborus fornicatus*, Eichh., in the branches of tea are difficult to make, since the fungous mycelium on which the larvae feed dries out when the infested branches are opened, but data from which some details of the bionomics could be estimated were obtained in the course of observations made in Ceylon at an altitude of 3,500 ft. in 1936, an account of which is given.

The female constructs a gallery in which the eggs are deposited and the development of the brood is completed ; these galleries are not extended by the larvae. The males have no wings and remain in the galleries in which they develop, but the females fly to other branches, in which they construct fresh galleries. A total of 509 galleries was examined between 8th July and 10th October. The majority of them occurred at the nodes of branches about ½ in. in diameter. The pre-oviposition period from the beginning of the construction of the gallery and the egg, larval and pupal stages are estimated to last 8·4, 6·9, 15·2 and 7 days, respectively, but the pupal stage is probably shorter. Females that oviposit lay an average of 9 eggs in 10 days and a maximum of about 34 ; oviposition probably does not continue for longer than 49 days. Some females did not oviposit during the period of observation, although they remained in the galleries they had constructed, and others made galleries and left them before depositing any eggs. The maximum number of offspring in any one gallery was 34, and in only 9 did the number exceed 25. The ratio of males to females among the progeny was 1 : 3. Since the rate of oviposition was rather higher than the rates of pupation and adult emergence, it is thought possible that the parent female may remove dead larvae, in which stage mortality is most likely to occur, from the gallery ; this is supported by the fact that both the percentage of galleries containing dead larvae and the ratio of dead to living larvae were higher when the parent female was absent.

Drosophilids were found in 58 of the 509 galleries, and in 17 of these there was an exudation of sour-smelling fluid, resulting from some process of fermentation, by which the Drosophilids were probably

attracted. These galleries also contained most dead Scolytid larvae, which the author suggests may have been destroyed by the fluid or by the Drosophilids [*cf.* **9** 217].

[Kozhanchikov (I. V.).] **Кожанчиков (И. В.). The Importance of the physical Conditions of Environment upon the Development of the Eggs of the Gipsy Moth** (*Lymantria dispar* **L.).** [*In Russian.*] —*Bull. Plant Prot.* 1940 no. 3 pp. 3–16, 5 graphs, 45 refs. Leningrad, 1940.

The following is substantially the author's summary. The experiments described show that the threshold of development of the eggs of *Lymantria dispar*, L., is 6·8°C. [44·24°F.] before the diapause and 5·7°C. [42·46°F.] after it. The threshold did not change in the course of the spring development of the egg, in contrast to the observations of Rubtzov [*R.A.E.*, A **27** 314], and was the same for eggs taken in the field before the end of the diapause (at the end of February) and for those taken shortly before hatching (in May). The eggs are tolerant of humidity, and before the diapause they were able to develop almost normally at a relative humidity of 100 per cent. After the end of the diapause, 100 per cent. relative humidity was unfavourable, especially at high temperatures. The optimum temperature for the development of the eggs was about 18–20°C. [64·4–68°F.] ; lower temperatures were less unfavourable than higher ones, especially during the period of spring development. Development in spring was possible at alternating temperatures within the limits of −6 and 9°C. [21·2 and 48·2°F.]. Eggs that developed under these conditions hatched normally. Variations of the distributions of the eggs in nature on southern and northern exposures are connected with the reactions of the females to thermal conditions and favourably affect the development of the eggs. Oviposition on the southern side of stones and on the crowns of trees permits the eggs to develop at lower temperatures. The diapause of the eggs is well characterised by a sharp reduction in the consumption of oxygen and in catalase activity. The thresholds of development and the sums of effective temperatures necessary for the development of the eggs are closely conected with those characteristic of deciduous trees, especially some of the most important food-plants of the larvae, such as willow. The relationship with the development of conifers is less close.

[Prikhodkina (T. D.).] **Приходкина (Т. Д.). Poisoned Baits as a Control Measure against the Caterpillars of Cutworm on Beets.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 17–22, 2 refs. Leningrad, 1940.

The experiments described were carried out in the Ukraine in 1937 and 1938 to test the value of poisoned baits for the control of larvae of *Agrotis segetum*, Schiff., on sugar-beet. The baits consisted of 10 parts by weight finely chopped leaves of *Atriplex tatarica*, sawdust or horse dung mixed with 1 or 2 parts molasses and 0·5 part glycerine in 1938, and 10 parts chopped leaves of *A. tatarica*, dry oilcake or wheat bran with 1 part molasses in 1939 ; they were poisoned with 1·5–5 per cent. sodium fluosilicate or sodium fluoride or 0·6–2·5 per cent. Paris green, and were evenly distributed along the rows of beet at the rate of 360 lb. of the chopped leaves and 180 lb. of the other carriers per

acre. The results, which were estimated by comparing the numbers of living larvae on the treated and the control plots and those on the treated ones before and after the distribution of the baits, showed some inconsistency but indicated that the leaves of *A. tatarica* were the most attractive bait and sodium fluosilicate the most effective poison; the percentage control as compared with untreated plots averaged 63 in 1938 when the percentage poison in the bait was 1·5, and 74, 77 and 84 in 1939, when it was 1·5, 2·5 and 5, respectively. Sodium fluoride at 2·5 and 5 per cent. gave 62 and 72 per cent. control in 1939. When the carrier was wheat bran, the percentage control averaged 79 and 77 for 5 per cent. sodium fluosilicate and sodium fluoride, respectively, and 54 for 2·5 per cent. Paris green. Oilcake, horse dung and sawdust were not particularly attractive.

In further experiments, chopped leaves of *A. tatarica* mixed with sodium fluosilicate were more effective than whole shoots of the plant soaked in any of the poisons and distributed in small heaps about a yard apart. In the laboratory, the larvae readily consumed *Atriplex*, but accepted horse dung or sawdust only when they were deprived of other food.

The bait recommended is therefore 10 parts finely chopped leaves of *A. tatarica*, for which *Chenopodium album* could well be substituted, and 1 part molasses, mixed with 2·5 per cent. sodium fluosilicate, or 2·5–5 per cent. sodium fluoride. The baits should be broadcast at intervals of about a week, since they usually dry out in about 5 days.

[Ermolaev (M. F.).] **Ермолаев (М. Ф.). The Biology of *Thrips linarius* Uz. and Control Measures against it.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 23–34, 6 figs., 6 refs. Leningrad, 1940.

Thysanoptera cause a considerable reduction of the yield of flax in various parts of the Russian Union, but little is known of the species concerned. Of those taken on flax in the Udmurt Republic (west of the Ural Mountains) in 1938 and 1939, *Thrips lini*, Lad. (*linarius*, Uzel) was by far the commonest, *Aeolothrips fasciatus*, L., and *Haplothrips* sp. were fairly numerous, and *Taeniothrips atratus*, Hal., *Chirothrips manicatus*, Hal., *Limothrips denticornis*, Hal., *Thrips physapus*, L., and *Frankliniella intonsa*, Tryb., were rare. The only larvae observed were those of *T. lini* and, in much smaller numbers, *A. fasciatus*. All stages of *T. lini* and its distribution are described. Observations on its bionomics showed that the adults hibernate in the soil at a depth of 8–16 ins. and emerge when the soil temperature reaches 14°C. [57·2°F.]. Emergence was completed in 24 days in both years, and in 1939 did not reach its peak until after 17th June. The males tended to remain on weeds in the fields in which they had hibernated, but the females flew in search of flax [*cf. R.A.E.*, A **27** 233], covering considerable distances. A list of the wild and cultivated plants on which the thrips were found is given. On flax, they occurred chiefly at the growing point or on the inner side of the sepals of the buds and young fruits. They were sensitive to changes in weather and most active on calm clear days. The eggs were deposited deep in the plant tissues near the growing point, if the flower buds had not formed, or inside the calyx on more mature plants. In 1939, oviposition began on 10th June and reached its peak in late June and the first ten days of July.

The egg stage lasted 5 days. Except for single individuals on vetch (*Vicia sativa*), the larvae were found only on flax, and most of them occurred in the calyx. They completed their feeding in 23–25 days, entered the soil and became prepupae about 4 days later. In 1939, the mass migration of the larvae into the soil took place in mid-July, but owing to the protracted period of oviposition, some of them were still immature when the flax was pulled. A few of them completed their development while it was being dried, but most of the younger ones did not survive this process. The prepupal and pupal stages were passed in a small cell in the soil at a depth of 4–10 ins. and together lasted 10–12 days. The young adults remained in the soil and migrated to hibernation depth with the onset of cold weather.

By sucking the sap of the plants the adults and larvae kill the growing point, and cause profuse branching and the drying up and shedding of the flower buds and immature fruits. The plants are dwarfed and the fibre is thus shortened. The capsules in infested heads often burst open before ripening, enabling the larvae to feed on the seeds. The number and weight of seeds from such injured capsules were reduced by 22·9 and 33·4 per cent., respectively. In a plot in which the thrips were abundant, the yield of stems was reduced by 41·9 per cent. and that of the seeds by 37·4.

Many larvae of *T. lini* were destroyed by those of *A. fasciatus*, and up to 30 per cent. of the adults were parasitised by larvae of the Erythraeid mite, *Hauptmannia brevicollis*, Oudm. Varying the date of sowing between 5th May and 15th June showed that early sown flax was the least injured and gave the highest yield of stems and seeds. The use of fertilisers increased the resistance of the plants to infestation. The losses caused were also reduced by increasing the rate of sowing. Field experiments with insecticides, the results of which are shown in tables, indicated that a marked reduction in infestation and a considerable increase in yield can be obtained with sprays of 0·3 or 0·2 per cent. anabasine sulphate in 0·4 per cent. soap solution, or with a dust containing 5 per cent. anabasine sulphate or one consisting of equal parts of naphthalene and lime.

[Egorova (E.).] **Егорова (E.). About the reiterated Hibernation of *Apion apricans* Herbst.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 35–36. Leningrad, 1940.

The fact that clover weevils of the genus *Apion* can hibernate more than once [*cf. R.A.E.*, A **24** 440] was confirmed during investigations on *A. apricans*, Hbst., in the Provinces of Moscow and Tula. Of about 1,000 overwintered weevils collected early in the spring of 1936 and kept throughout the summer in insectaries with clover plants, on which the females oviposited, some 50 males and females were still alive in October, although the weather had been hot and dry. They were placed in soil covered with dry leaves in a glass jar, which was sunk into the ground in a field with its top level with the soil surface. All of them were alive on 16th May 1937, and the females oviposited from 20th May until the end of July, when most of them died. They laid almost as many eggs in 1937 as females that had hibernated only once. Five weevils entered hibernation for a third time, but their subsequent fate is unknown. In 1937, a considerable number of the weevils that had emerged in 1936 and were kept in the laboratory oviposited and entered hibernation for a second time.

[Berezina (V. M.).] **Березина (В. М.). A Fragment to the Method of investigating the Part played by the Light in the Life of Insects.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 37–38. Leningrad, 1940.

It is commonly believed that Tenebrionids are nocturnal insects and prefer shade during the day, and consequently, that trap heaps affording shade should be used for their control [*cf. R.A.E.*, A **29** 571], but observations showed that though *Blaps halophila*, Fisch., *B. lethifera*, Marsh., and *Pedinus femoralis*, L., hide under stones, heaps of weeds, etc., during the day, *O. sabulosum* crawls about on the surface of the ground, and only occasionally shelters under grass or lumps of soil. It was also found that *P. femoralis* makes its way under trap-heaps of dry grass or mulch only at night, whereas *O. sabulosum* and *Dasus pusillus*, F., do so in the daytime as well.

The difference in the reaction to light of these Tenebrionids was confirmed in laboratory tests in which 100 adults of *Blaps* spp., *P. femoralis* or *O. sabulosum* were placed in the centre of an apparatus having alternate light and dark chambers along the periphery; 82, 71 and 32 of the three groups, respectively, entered the dark chambers, and all the others the light ones. In further experiments, the beetles were placed in tubes made from blue, green, yellow, orange and red light filters joined end to end in pairs or all five together, stopped with transparent uncoloured material and exposed to daylight. *Blaps* spp. preferred the yellow and green sections and avoided the blue and especially the red ones. *P. femoralis* also preferred the yellow and green light, with a slight preference for the latter, and also avoided blue and red, though to a less extent than *Blaps* spp. *O. sabulosum* concentrated chiefly in the blue light and was indifferent to the others.

[Gilyarov (M.).] **Гиляров (М.). Resistance of *Vicia pannonica* to the Injuries caused by *Sitona* spp.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 39–40. Leningrad, 1940.

In the course of field experiments in the Province of Moscow in the spring of 1937, it was observed that weevils of the genus *Sitona*, which severely damaged common vetch (*Vicia sativa*) in an experimental plot that had been under clover in the preceding year, caused negligible injury to Hungarian vetch (*V. pannonica*), although it was sown in alternate rows with *V. sativa*.

[Kiseleva (E. N.).] **Киселева (Е. Н.). Corn Bugs—*Eurygaster maurus* and *Aelia acuminata* in the Conditions of the Gorki Region.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 41–43. Leningrad, 1940.

Pentatomids caused considerable injury to wheat throughout the Province of Gor'kiĭ in 1937–39. The more important species found in fields of wheat and winter rye and on weeds in 1939 were, in order of decreasing abundance, *Eurygaster maura*, L., which predominated on winter and particularly spring wheat, *E. austriaca*, Schr., and *Aelia acuminata*, L., which was commonest on winter rye. Examination of ears of winter wheat showed that about 38 per cent. of the grains were injured and that such grains lost from 15·55 to 35·85 per cent. in weight. Flour ground from this grain was quite unsuitable for baking [*cf. R.A.E.*, A **29** 574, etc.].

Observations in the summer of 1939 on the habits of *A. acuminata* showed that the bugs remained concealed during May and the first half of June, but appeared on weeds in mid-June, when the mean temperature had risen to 21°C. [69·8°F.]. Their presence was associated with that of couch grass [*Agropyrum repens*]. They were abundant on low, sparse vegetation, and laid their eggs in batches on the leaves, stems and ears of *A. repens* and other grasses, The oviposition period lasted from 22nd June to 25th July in the laboratory ; young nymphs occurred in the field in August. On 25th August, both adults and nymphs were found under the sheaves of winter rye and near fallen ears of winter wheat. It is suggested that quick removal of the grain from the fields and the destruction of all remnants of the crop after harvest would deprive the nymphs of food, so that they would not be able to complete their development.

[Vasil'ev (V. P.).] **Васильев (В. П.). Materials upon the Ecology of the Vine Moth (*Clysia ambiguella* Hübn.) in the Ukrainian Socialist Soviet Republic and Investigations of dustlike Insecticides as a Control Measure against it.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 44–53, 1 graph, 13 refs. Leningrad, 1940.

An account is given of observations in 1933–35 on the bionomics of *Clysiana* (*Clysia*) *ambiguella*, Hb., on grape vines at Berdyansk and Odessa, in the Ukraine. This moth has two generations a year there and hibernates in the pupal stage under loose bark on the stems of the vines or in cracks in the poles.

In the laboratory, the overwintered pupae developed at 10°C. [50°F.] but not at 5·5°C. [41·9°F.], and the threshold of pupal development calculated from Blunck's formula [*cf. R.A.E.*, A **13** 389] was 6·6°C. [48·84°F.]. For practical purposes, development can be assumed to begin in the field when the mean temperature reaches 9–10°C. [48·2–50°F.]. At mean temperatures of 10·3 and 14·3°C. [50·54 and 57·74°F.], the pupal stage was completed in 43 and 25 days, respectively, the number of day-degrees required thus being 159 and 192 C. [286·2 and 345·6 F.]. The average for these and intermediate temperatures was 175 day-degrees C. [315 F.].

The adults emerge when the buds on the vines begin to open, or about a month before flowering ; the date varied from early to late May, but adults can be expected when the average sum of effective temperatures approaches completion. The duration of the flight ranged from 9 to 21 days. The first-generation eggs are laid singly on the flower buds. In the laboratory, they hatched in 7, 13 and 22 days at 19, 15 and 11°C. [66·2, 59 or 51·8°F.], but no eggs hatched at 23 or 27°C. [72·4 or 80·6°F.]. The duration of the egg stage in the field was not ascertained, but the period that elapsed between the appearance of the first eggs and that of the first larvae was 6 days at 18·8°C. [65·84°F.] and 9 at 14°C. [57·2°F.]. The larvae hatch over a considerable period; they burrow in the flower buds and, as they pass from one bud to another, cover the inflorescences with a web. The larval stage lasted about 20 days. Pupation takes place on the inflorescences, and the pupal stage lasted 15 and 11 days at mean temperatures of 19 and 23°C. [66·2 and 73·4°F.], respectively, the sum of effective temperatures required being the same as for the overwintered pupae. The first-generation adults emerge when the grapes reach the size of a pea, and

are present for 12–29 days. The females emerge with undeveloped ovaries and require supplementary feeding. In the field, at mean temperatures of 14–15 and 17–19°C. [57·2–59 and 62·6–66·2°F.] in spring, oviposition began 7–10 and 5–7 days, respectively, after the beginning of the flight ; while in summer, the interval was 5–7 days at 21–25°C. [69·8–77°F.]. The second-generation eggs are deposited on the grapes ; and the first larvae were observed 6–10 days after the first eggs. They feed in the grapes, but leave them at harvest and shelter beneath the loose bark on vines, etc. ; pupation occurs in October.

Insecticides for the control of the larvae should be applied just before the eggs hatch, and the correct dates for a given season can be ascertained by means of light-traps set out about 10 ins. above the ground when it is apparent from consideration of the temperature sum necessary for pupal development and current temperatures that the adults are about to emerge. Examples of the working of this method are given. Since hatching is protracted, particularly in the second generation, the treatment should be repeated after 10–12 days. In laboratory experiments, in which artificially infested bunches of grapes were dusted with various stomach poisons, the percentage mortality in two days was 95–100 for undiluted barium fluosilicate or a proprietary arsenical (Kupfermeritol) containing 11·39 per cent. As_2O_5 and 9·77 per cent. As_2O_3 ; 80 for mixtures of Paris green and lime (1 : 5 and 1 : 7) or barium fluosilicate and lime (1 : 1) ; and 65 for another proprietary arsenical (Meritol) containing 20·39 per cent. As_2O_5 and 0·85 per cent. As_2O_3. In field experiments against the larvae of both generations, the effectiveness of the dusts was estimated by comparing the percentages of injured bunches on treated and untreated vines. The dusts were applied at a rate equivalent to about 14½ lb. per acre when the larvae were hatching. The best control (64–95 per cent.) was given by Kupfermeritol, but the sample used caused considerable scorching. Undiluted barium fluosilicate was not used as it is known to injure vines. Barium fluosilicate and lime (1 : 1) and Paris green and lime (1 : 7) gave 59–74 and 56–74 per cent. control, respectively, and scorching was insignificant. Meritol was less effective. Kupfermeritol gave 65 per cent. control when applied from an aeroplane ; the grapes were covered with an even, thin layer of the dust and scorching was slight. Tests with the mixtures of Paris green or barium fluosilicate to determine the best rate of application from the ground showed that using more than about 14½ lb. per acre against the larvae of the first generation did not appreciably improve the control, whereas at least 18 lb. should be applied against the second generation.

[Kraĭter (A. D.).] **Крайтер (А. Д.). The Cause of the toxic Effect of Emulsions of Petroleum Oils upon Fruit-trees at the Time of their Vegetation.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 54–66, 11 refs. Leningrad, 1940.

In view of the fact that injury to plants in Russia has often resulted from summer applications of emulsions of petroleum oil, even when it has been refined so as to reduce the content of unsaturated hydrocarbons to not more than 5–10 per cent., laboratory investigations were carried out, followed by field tests in the Province of Krasnodar (northern Caucasus), to determine its causes. The oils used, the properties of which are described, were obtained from three sources

in the Russian Union ; each was separated into five fractions, distilling at 270–300, 300–350, 350–400, 400–450 and 450–500°C., which were refined by treatment with alkali or 95 per cent. sulphuric acid at concentrations of 10, 50 or 200 per cent. Emulsions were prepared containing (by weight) 70 per cent. oil, 15 per cent. water and 15 per cent. soda resin soap, diluted to contain 2 per cent. oil and applied to apple trees in summer. Two industrial oils of a low degree of refinement (with 6 and 12 per cent. sulphuric acid) and having a viscosity of 1·51–1·43° Engler and a boiling range of 270–525°C. were emulsified with soda resin soap or basic ferrous sulphate and tested at the same time.

In all instances, the leaves of the variety of apple on which the experiments were carried out proved very resistant, but the fruits sustained more or less considerable injury. All the emulsions prepared with resin soap caused scorching, which differed in intensity with the fraction and the origin of the oil [*cf. R.A.E.*, A **29** 584]. The degree of scorching varied inversely with the boiling range of the oils, though the amount of oil that remained on the leaves increased directly with its boiling-range. This indicated that the naphthene acids present in the light fractions were probably responsible for the injury. No conclusions were drawn as to the part played in the scorching by the degree of refinement of the oils, but those treated with 50 per cent. sulphuric acid appeared to cause the most injury. Scorching increased with an increase in the concentration of the oil in an emulsion. No injury to the leaves or fruits was caused by the industrial oils emulsified with basic ferrous sulphate, and the fact that these emulsions left considerably more oil on the leaves than those made with the resin soap indicated that the scorching caused by the latter is due chiefly to the nature of the emulsifier.

In preliminary experiments on the oxidation of the oils, thin layers of undiluted oils or concentrated emulsions (60–70 per cent. oil) were smeared on sheets of paper, which were hung in the open for 96 hours. In all cases oxidation, in which naphthene acids were formed, occurred, and the process was intensified by the presence of resin soap. During the period of exposure, the acid contents of the undiluted oils increased 8–10 times, while that of the oils in the emulsions increased 30–70 and 4–6 times when they were emulsified with resin soap and basic ferrous sulphate, respectively. Oxidation was reduced by higher refinement of the oils.

The author concludes that the injurious effects of the oils on the leaves and fruits is due chiefly to the acid products, mainly naphthene acids, that are formed as a result of oxidation. In this process, soap emulsifiers act as positive catalysts, whereas mineral emulsifiers, such as basic ferrous sulphate, act negatively or react with the acid products and render them harmless. It appears, therefore, that less refined oils emulsified with basic ferrous sulphate would be safe to use for summer sprays, while highly refined oils emulsified with soap would not.

[Paĭkin (D. M.) & Leĭtzis (P. R.).] **Пайкин (Д. М.) и Лейцис (П. Р.). The Study of Dichloretan as a Substitute for Carbon Bisulphide in the Time of the Quarantine Fumigation of Seeds.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 73–77. Leningrad, 1940.

Since practically the only fumigants used in the Russian Union for the treatment of seeds in quarantine are hydrocyanic acid gas, which

is not sufficiently effective as an ovicide, and carbon bisulphide, which is highly inflammable, laboratory experiments were carried out in Leningrad with ethylene dichloride (dichlorethane), the properties of which are described. It was used at the rate of 4, 6 and 8 oz. per 10 cu. ft., in comparison with carbon bisulphide at rates of 1·5 and 3 oz. to fumigate small lots of wheat, oats and peas having a moisture content of 14 per cent., together with adults of *Calandra granaria*, L., and *Bruchus pisorum*, L., and adults and eggs of granary mites. The exposures were 24, 48 and 96 hours for fumigation at atmospheric pressure and a temperature of 16–20°C. [60·8–68°F.] and 24 and 48 hours for fumigation in a vacuum of 20 ins. mercury at 14°C. [57·2°F.]. All treatments gave 100 per cent. mortality of the beetles and adult mites, and all gave 100 per cent. mortality of the eggs, except ethylene dichloride at atmospheric pressure, which, in each test, allowed a few of them to survive. The treatments with ethylene dichloride had no effect on the germination of the fumigated seeds. Its use for vacuum fumigation of grain in quarantine at the lowest concentration and shortest exposure tested is therefore recommended.

[Meĭer (N. F.).] **Мейер (Н. Ф.). Parasites hatched in USSR in 1938–1939 out of the Eggs of the Corn-bug** *Eurygaster integriceps* **Osch.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 79–82. Leningrad, 1940.

Parasites reared in 1938–39 in various parts of the Russian Union from eggs of the Pentatomid, *Eurygaster integriceps*, Put., comprised the Encyrtid, *Schedius telenomicida*, Vasil'ev, and the Scelionids, *Trissolcus simoni*, Mayr, *Dissolcus rufiventris*, Mayr, *Telenomus sokolowi*, Mayr, *T.* (*Phanurus*) *politus*, Thoms., *Microphanurus vassilievi*, Mayr, *M. semistriatus*, Nees, and *Hadronotus pedester*, Kieff. A key to them is given, together with descriptions of the adults and records of their distribution in the Russian Union and the alternative hosts of some of them. *T. sokolowi* and *M. semistriatus* are recorded from eggs of *E. maura*, L., *H. pedester* from those of *Aelia acuminata*, L., *T. simoni* from those of *E. maura*, *Eurydema ornatum*, L., and *Dolycoris baccarum*, L., and *S. telenomicida* from those of *Syromastes* (*Mesocerus*) *marginatus*, L., *Carpocoris pudicus fuscispinus*, Boh., and *D. baccarum*.

Observations in the Provinces of Rostov and Stalin showed that the local distribution and frequency of the parasites varied considerably. The author suggests that their distribution in the fields may depend on the proximity of their hibernation quarters. Thus, the percentage parasitism of the eggs of *E. integriceps* by *M. semistriatus*, which hibernates under the loose bark of trees [*cf. R.A.E.*, A **30** 148], increased with the proximity to forests, but that by *D. rufiventris*, which hibernates among weeds and is not connected with forests, did not.

[Nikitina (T. F.).] **Никитина (Т. Ф.). Utilisation of** *Trichogramma* **against** *Barathra brassicae* **L.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 83–84. Leningrad, 1940.

In view of the importance of *Mamestra* (*Barathra*) *brassicae*, L., as a pest of cabbage near Gor'kiĭ, on the Volga, experiments were carried out in July 1939 on the value against it of an egg-parasite of the genus *Trichogramma*. The adult parasites were released from paper tubes

on plots of early or late cabbage two or three times between 3rd and 31st July at the total rate of 80,000–120,000 per acre. The results are shown in tables. Considerable percentages of the eggs were parasitised, and the larval populations on the treated plots were from 24·5 to 83·3 per cent. as large as those on control plots, which were over 1,000 ft. away. The parasite was ineffective against the eggs of *Plutella maculipennis*, Curt.

[Elago (L. F.).] **Елаго (Л. Ф.). About the Utilization of *Silvestrina tyrophagi* Dombr. as a Control Measure against *Tyrophagus noxius* L.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 85–86. Leningrad, 1940.

[Dombrovskaya (E. V.).] **Домбровская (Е. В.). Description of a new Cecidomyiid, *Silvestrina tyrophagi* sp. n., destroying the Mite, *Tyrophagus noxius*, Zachv.** [*In Russian.*]—*T.c.* pp. 87–88, 5 figs. (With a Summary in German.)

Larvae of a Cecidomyiid that is described in the second paper from larvae, pupae and adults of both sexes as *Silvestrina tyrophagi*, sp. n., were observed in 1938–39 to be predacious on *Tyrophagus noxius*, Zkhv., in stored hemp seed in the northern Ukraine. No eggs were found in the material examined, but adults were present; females placed in test tubes oviposited, and the eggs, which are briefly described, were laid in batches of 2–40, or occasionally singly. The larvae hatched in 4–7 days and at once attacked the mites, up to 3–4 larvae attaching themselves to single individuals.

The larval, prepupal and pupal stages lasted 14, 5 and about 8 days, respectively, and pupation took place in cocoons at the bottom of the heap of seed, the cocoons sometimes being attached to a seed or to several seeds stuck together. No cocoons were spun in July, though pupation occurred. At a temperature of 20–25°C. [68–77°F.], the life-cycle from egg to adult was completed in about a month.

Laboratory experiments on the use of the Cecidomyiid for the control of mites in hemp seed gave promising results, and these were confirmed in another experiment in which eggs, larvae and adults were introduced into about half a ton of infested hemp seed. The number of mites present was reduced by 78·5 per cent. after a month.

[Bruizgalova (V. A.).] **Брызгалова (В. А.). Some Data about a Type of Virus Disease (Zakooklivanije) of Oats in the Conditions of the Baïkal-Lake Region.** [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 124–129, 2 refs. Leningrad, 1940.

Oats on the western and eastern sides of Lake Baikal (eastern Siberia) are attacked by the virus disease known as zakuklivanie [*cf. R.A.E.*, A **29** 13], which causes serious crop losses in some years. In experiments, the virus was transmitted by the nymphs and adults of *Delphacodes* (*Delphax*) *striatellus*, Fall., but not by the Jassid, *Laevicephalus* (*Deltocephalus*) *striatus*, L., or through the egg of the Delphacid.

To the west of the Lake, *D. striatellus* occurs mainly on cultivated land and has two generations a year. Hibernation takes place in the third nymphal instar, and optimum conditions for it are found in

depressions (from which the snow cover is not blown away in winter) in fields of oat stubble and adjoining fallow land with steppe vegetation. The resulting adults oviposit on the leaf-sheaths and blades of the first three leaves of oats and to a less extent on *Agropyrum repens*, but those of the summer generation do so chiefly on weeds, such as *A. repens*, *Setaria viridis*, *Galeopsis tetrahit* and *Scutellaria scordiofolia*. Infected individuals occur in all the fields of the crop rotation, but are most abundant on oats and oat stubble. Tests with Delphacids from infected oats showed that those able to transmit the disease are most numerous in May and June, and are scarce in the first generation, which was present in July. It is suggested that the Delphacids of the summer generation, which live for only about 30–35 days, do not have sufficient time to acquire the virus, or that it is present in them in a form that is less virulent to oats.

A similar disease also occurred in barley and particularly in wheat, and the virus in wheat was found to be identical with that in oats; it caused deformation of the ears and total or partial loss of seed. The latter was frequently non-viable.

Investigations on the effect of agricultural measures showed that in years when the disease is not prevalent the date of sowing does not influence the extent of infection of oats; but when the disease is widespread (as it was in 1937 and 1938), oats sown before 17th May suffer considerably more than those sown in the second half of May or early June. Sowing in June, however, would be too late for some years. Cultivation of oats in fields that had also been under this crop in the preceding year favoured the increase of the Delphacid and infection among the plants; oats sown after wheat or spring rye were considerably less infected. The percentage infection was lower in densely sown plots.

MASSEE (A. M.). **The British Brown and Green Leaf Weevils associated with cultivated Fruit Trees and Bushes.**—*J. Pomol. hort. Sci.* **19** no. 1–2 pp. 78–81, 4 refs. London, 1941.

A key is given to the adults of the five species of *Phyllobius* that feed on the leaves of cultivated fruit trees and bushes in the British Isles, *viz.*, *P. argentatus*, L., *P. pyri*, L., *P. maculicornis*, Germ., *P. calcaratus*, F., and *P.* (*Nemoicus*) *oblongus*, L. *P. oblongus* is the most abundant and can be distinguished from the others by its brown elytra. It feeds on many plants, but prefers apple, pear, plum, cherry, hazel [*Corylus*] and walnut; it also attacks apple, plum and pear stocks in nurseries and partly defoliates young nursery trees. After feeding on the young foliage and petals for 2–3 weeks, causing considerable injury in some seasons, the weevils migrate to oak, wild hazel and other trees and shrubs. There is one record of the larvae attacking the roots of strawberry [*R.A.E.*, A **8** 139]. *P. argentatus* is the most abundant green weevil in orchards and nurseries and attacks apple, pear, plum, and hazel; it also feeds on soft fruits and on root-stocks and young fruit trees in nurseries. It has not been recorded as a pest of fruit trees in Britain, however, because it has hitherto been erroneously identified as *P. maculicornis*. The latter normally feeds on oak but has occasionally been found by the author in derelict apple orchards, especially on the trees nearest the hedgerows; it does not appear as a rule until June. In the laboratory, it preferred the foliage of scrub oak to that of apple.

P. pyri occurs on most kinds of cultivated fruit, but is most plentiful on pear, plum and damson ; it also feeds on woodland trees and shrubs and on nettle. *P. calcaratus*, which normally feeds on alder, is common on black currant in some parts of Kent, but is not of economic importance ; the larvae have been recorded as a minor pest of strawberry in Germany. *P. pomonae*, Ol., is common in Kent, but occurs on oak and is not associated with cultivated fruit.

Recent observations on the immature stages of *Phyllobius* indicate that the larvae of some species live in the soil and feed on the roots of couch grass (*Agropyrum repens*).

GREENSLADE (R. M.). **The Migration of the Strawberry Aphis** *Capitophorus fragariae* **Theob.**—*J. Pomol. hort. Sci.* **19** no. 1–2 pp. 87–106, 1 pl., 7 figs., 16 refs. London, 1941.

The following is based on the author's summary of this paper, which includes a brief account of the bionomics of *Capitophorus fragariae*, Theo., and its importance as a vector of the viruses of yellow-edge [*R.A.E.*, A **23** 290] and crinkle [**27** 395] of strawberry [*Marmor marginans* and *M. fragariae*, respectively, of Holmes], and details of the results of observations in Kent in 1936–39 on the factors influencing the migration of the winged adults. Under natural conditions, this Aphid is confined almost entirely to cultivated strawberry plants [**29** 28]. The winged forms do not migrate to an alternate food-plant, but are of economic importance because they spread virus diseases from field to field. The spring alates are adult for a short period in May or June and often occur in very large numbers. Their occurrence is not correlated with the flowering period of the food-plant. The autumn alates are less numerous and occur over a longer period.

The activity of winged Aphids is known to be influenced by temperature and humidity [**23** 492 ; **24** 551 ; **29** 180], and evidence was obtained during the present investigations that it is increased by the influence of light. Favourable conditions are temperatures above 60°F., relative humidities below 70 per cent., and wind velocities below 3 miles per hour. Charts showing the temperature, relative humidity and wind speed prevailing during the periods of production of the winged generations of *C. fragariae* are given and show that extensive migration is likely to occur only during comparatively short periods. They also show that extended migration of the autumn winged Aphids is unusual but can sometimes occur, and that the transmission of virus disease at that season is therefore possible.

Migrating adults were able to find single strawberry plants among other crops or among thick grass. They fly in all directions and are apparently not much affected by the direction of the wind, since they do not fly unless its velocity is low. Plants became infested at distances of at least 400 yards from infested plots of strawberries, and there is little doubt that the Aphids can migrate farther than this. Wild strawberry plants growing under natural conditions did not become colonised by *C. fragariae*, although cultivated plants growing under exactly similar conditions readily became infested. Under certain unnatural conditions, wild strawberry plants may support large colonies. The possible reasons for this are discussed, and experiments are described that suggest that a sense of smell is not concerned with the choice of a food-plant by this species.

JANISCH (E.). **Ueber die Bewertung der Mortalitätsfaktoren beim Massenwechsel von Schadinsekten.** [On the Evaluation of Mortality Factors in the Variation of Abundance of Insect Pests.] —*Z. angew. Ent.* **28** pt. 2–3 pp. 241–253, 1 fig., 5 graphs, 18 refs. Berlin, 1941.

The author considers that the evaluation of mortality factors affecting insect abundance is possible only on a physiological basis [*cf. R.A.E.*, A **27** 99]. Opinions vary as to the relative importance of individual factors, and the red forest ant, *Formica rufa*, L., is an example of such divergence in respect of a biotic factor checking harmful insects. The various views as to the effectiveness of this ant are discussed. Most individuals in an insect population are destroyed before they are able to reproduce, as they have only a slight resistance to unfavourable environmental conditions. For instance, the young larvae of *Lymantria monacha*, L., are very sensitive to dryness, the effect of which was demonstrated in the laboratory by a percentage mortality of 98 among larvae kept at 55 per cent. relative humidity, as compared with 5 among those kept in saturated atmosphere. Especially unfavourable is a combination of dryness and hunger, which latter may easily occur if the buds of trees open late. A favourable microclimate is essential if a large number of individuals is to survive, but even if the percentage mortality is 90, the survivors are sufficiently numerous to give rise to an outbreak in a few years. Many factors contribute to a high mortality, but the majority, including parasites, predators and diseases, become operative only following a mass increase of the insect concerned, and parasites become really effective only at the end of an outbreak, when the pest has already been decimated by other factors. Nor do existing observations justify the artificial establishment of such enemies as birds and ants. The greatest influence is exercised by weather and food, and the action of these factors on mortality and composition of the surviving population needs further investigation. Polyhedral disease appears to be responsible for more mortality among young individuals of *L. monacha* and *L. dispar*, L., than has hitherto been assumed.

SCHWERDTFEGER (F.). **Ueber die Ursachen des Massenwechsels der Insekten.** [On the Causes of Variation in Abundance in Insects.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 254–303, 3 graphs, 109 refs. Berlin, 1941.

This is a detailed discussion of the theories that have been advanced to explain the variation in abundance of insects and the factors that affect it.

SCHIMITSCHEK (E.). **Beiträge zur Forstentomologie der Türkei IV. Die forstentomologischen Zonen der Türkei.** [Contributions to the Forest Entomology of Turkey. IV. Zonal Distribution of Forest Insects in Turkey.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 304–323, 2 maps, 16 refs. Berlin, 1941.

Asiatic Turkey has extreme differences in climate and topography, with consequent variations in flora and fauna. The author divides it into ten zones, each with uniform characteristics, and gives brief surveys of the kinds of trees and insects found in forests in them.

Hofmann (C.). **Beiträge zur Bionomie des veilgrauen Kiefernspanners** *Semiothisa liturata* **Cl.** [Contributions to the Bionomics of the violet-grey Pine Geometrid, *S. liturata*.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 324–334, 8 figs., 23 refs. Berlin, 1941.

An account is given of insectary observations in Bavaria on the bionomics of the Geometrid, *Semiothisa liturata*, Cl., which occasionally participates in outbreaks of *Bupalus piniarius*, L., on pine in Germany. The material was obtained from pupae collected in the field. The adults emerged in May and laid their eggs on the bark of pine and spruce twigs singly or, sometimes, in pairs. On pine, a single egg was usually laid at the base of the needle sheath, and this habit well distinguishes the species from *B. piniarius*. Newly emerged females contained no mature eggs ; five unfertilised females contained from 44 to 78 eggs at the time of death, and since it is known that unfertilised Lepidoptera deposit only about a third of their eggs, it is estimated that females of *S. liturata* produce about 90–100 eggs each. The egg and the five larval instars are described. At 22°C. [71·6°F.] and 75 or 92 per cent. relative humidity, the egg and larval stages averaged 8 and 25 days ; those of *B. piniarius* required 13–14 and 64 days, respectively. Pines are the chief food-plants, but the larvae have also been recorded from spruce, juniper and silver fir [*Abies alba*]. The newly emerged larvae prefer to feed on the needles of the May shoots, but more mature ones feed on old needles. The form of injury is described and illustrated. The larvae pupate on the soil under the forest litter. As most of the pupae hibernated, it is concluded that there is usually only one generation a year, but a partial second may occur in some seasons. A list is given of the parasites of *S. liturata* recorded in the literature. From pupae collected in the field, the author bred the Ichneumonids, *Anomalon biguttatum*, Grav., and *Ichneumon nigritarius*, Grav., and the Tachinids, *Lydella nigripes*, Fall., and *Zenillia libatrix*, Panz. As *I. nigritarius* is an important parasite of *B. piniarius*, *S. liturata* should be of value to it as an alternate host.

Fahringer (J.). **Zur Kenntnis der Parasiten der Nonne** (*Lymantria monacha* **L.).** [The Parasites of the Nun Moth, *L. monacha*.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 335–358, 35 refs. Berlin, 1941.

This important paper is based on unpublished records of parasites of *Lymantria monacha*, L., made by the author and F. Tölg in Bohemia, Moravia and Lower Austria in 1901–14, and data from entomological institutes. It consists largely of keys to Chalcidoids and Proctotrupids that parasitise the eggs and to Ichneumonids, Braconids and Chalcidoids bred from the larvae and pupae. The keys include lists of the alternate hosts where these are known, and in some cases brief notes on the distribution, bionomics and frequency of the parasites. A list of Diptera bred from the larvae and pupae is given, and brief sections deal with parasites other than insects.

Kangas (E.). *Agrilus ater* **L., als Espenschädling in Finnland.** [*A. ater* as a Pest of Aspen in Finland.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 359–365, 5 figs., 7 refs. Berlin, 1941.

In 1938–40 the author observed *Agrilus ater*, L., severely injuring aspen [*Populus tremula*] in southern Finland. Other primary pests

present in the trees were *Saperda carcharias*, L., *S. perforata*, Pall., *Xylotrechus rusticus*, L., *Cryphalus bispinulus*, Egg., *Xyleborus cryptographus*, Ratz., and *Poecilonota variolosa*, Payk., and secondary pests were numerous. Entomological analyses [*cf. R.A.E.*, A **23** 403] are given of three infested trees in different stages of withering, made to ascertain the relation between *A. ater* and its associates. They indicate that *A. ater* is one of the most important primary pests of aspen, together with *S. carcharias* and *P. variolosa*. It attacks chiefly the lower part of the trunks of large trees that are still apparently healthy. Its life-history is briefly reviewed from the literature. The flight period occurs in the first half of July. The larvae mine in the cambium and only occasionally touch the sapwood. They pupate, not later than June, in the hard bark of the trunk, and not in the wood as do many other species of *Agrilus*. The life-cycle has been stated to require three years, but the author considers that it may be completed in two. The only parasite observed was the Braconid, *Ipobracon nigrator*, Zett., but many larvae were found dead in their mines, having apparently been killed by a fungus.

Jahn (E.). **Ueber Parthenogenese bei forstschädlichen *Otiorrhynchus*-arten in den während der Eiszeit vergletscherten Gebieten der Ostalpen.** [On Parthenogenesis in Species of *Otiorrhynchus* harmful to Forests in Regions of the Eastern Alps covered with Ice during the Glacial Period.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 366–372, 1 fldg. map, 11 refs. Berlin, 1941.

The author briefly reviews records of parthenogenesis in species of *Otiorrhynchus* in Europe and states that in the course of investigations in the Eastern Alps she observed that certain species were represented in limited areas by females only and in others by males and females. The districts in which only females occurred had almost all been covered with ice during the glacial period. The species observed were *O. chrysocomus*, Germ., *O. scaber*, L., and *O. salicis*, Ström, which are forest pests, and *O. chalceus*, Stierl.; the local distribution of the females only and the two sexes together are given for each of them. It is concluded that the females have a greater ecological valency than the males, which occur only under favourable environmental conditions.

Braun (R.). **Der Ueberwinterungsfrass der Tannenborkenkäfer.** [Hibernation Mining of Silver Fir Bark Beetles.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 373–387, 15 figs., 20 refs. Berlin, 1941.

Forests of fir [*Abies*] near Vienna are severely infested by the Scolytids, *Ips curvidens*, Germ., *I. spinidens*, Rttr., and *Cryphalus piceae*, Ratz. The first two breed in large numbers in stacks of firewood left in the forest, and the last in fallen slash and twigs, and they also breed in living trees, which are eventually killed by the injury. These bark-beetles, unlike many others, overwinter in short mines constructed for the purpose in firs. The two species of *Ips* overwinter in the bark of the trunks of mature trees, and *C. piceae* does so in bark on branches and twigs in the crowns. They fly considerable distances to find suitable quarters, and construct the mines in October. The beetles do not feed during the process and use the frass to stop up the entrances to the mines, ejecting some of it. They leave these mines in spring and breed in other material. In wet, cold springs, *I. curvidens* may be found in its winter quarters until early May.

The mines and the injury they cause to the trees are described in some detail. The beetles bore in the same trees year after year, and the bark eventually becomes scaly and detached. Layers of cork cambium are formed to shut off the mines from the living bark. The mines of *I. curvidens*, and occasionally those of *C. piceae*, reach to the sapwood, and as the layer of cork cambium extends to the cambium, the flow of sap is probably interfered with if the infestation is severe. The injury resulting from attack by *C. piceae* is the more serious since it is more intense and interferes with the flow of sap in a more susceptible region. When constructing its maternal galleries, *C. piceae* attacks the tree from above downwards, but in hibernation mining the branches die from below upwards because the older branches are longer exposed to this form of attack than the younger ones. Hibernation mining creates favourable conditions for breeding by secondary bark-beetles. It is therefore essential that all sickly or dying material should be removed from the forest at once. The bark should be removed from felled trunks, and all slash should be burnt. The stacks of firewood should be removed before they become infested. Failure to apply these measures may, if the weather is favourable, result in serious outbreaks of bark-beetles. The adults of all three species emerge from their hibernation mines at about the same time, and trap logs should be placed ready to receive them. Trunks injured by hibernation mining are not suitable for this purpose.

VON SZELÉNYI (G.). **Die Artengruppen *Tetrastichus flavovarius* auct. und *T. brevicornis* auct. Ein Beitrag zur Systematik der Gattung *Tetrastichus* Hal. s.l. (Hym. Chalc. Eulophidae).** [The Specific Groups *T. flavovarius* auct. and *T. brevicornis* auct. A Contribution to the Classification of the Genus *Tetrastichus* Hal. s.l.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 398–415, 9 figs., 29 refs. Berlin, 1941.

The author discusses, from a study of the literature and the results of breeding experiments, the scope of the genus *Tetrastichus* and the identity of the species that have been considered to be *T. flavovarius*, Nees, and *T. brevicornis*, Panz. He considers that the true *flavovarius* is referable to another genus, and that *T. flavovarius*, auct., is identical with the true *T. brevicornis*. The first available name for the species erroneously described by Nees as *T. brevicornis*, and so identified by subsequent authors, is *T. eurytus*, Wlk. Lists are given of the synonyms of *T. brevicornis* and *T. eurytus*, and these and four other European species of *Tetrastichus*, three of which are new, are described. A key to the six species and notes on their host relations are included.

MALENOTTI (E.). **Ueber die entomologischen Wirkungen einiger Mischkulturen.** [On the entomological Effects of some mixed Plantings.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 416–421, 3 figs. Berlin, 1941.

The author briefly discusses the effects on infestation by insects of the cultivation of mixed crops or of different crops in close proximity to one another. The insects cited as examples include certain Aphids

that require various food-plants in the course of their seasonal cycle. On the Mediterranean coast, the autumn generations of *Ceratitis capitata*, Wied., infest oranges, but in summer peach trees provide such favourable conditions as to enable the fly to breed in enormous numbers and render control impossible, with the result that peach trees growing near oranges in Sicily have had to be destroyed in order to protect the latter. In northern Italy, the first two or three generations of *Cydia molesta*, Busck, attack stone fruits from mid-April to mid-July, but from then until mid-October the fourth and fifth generations infest pear. Pear trees at a distance from peach are never attacked.

Tolunay (M.). **Experimentelle Untersuchungen über den Einfluss von Temperatur und Luftfeuchtigkeit auf die Entwicklung der *Hyponomeuta padellus* L.** [Experimental Investigations on the Influence of Temperature and Air Humidity on the Development of *H. padellus*.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 422–438, 9 figs., 4 graphs, 16 refs. Berlin, 1941.

Fruit trees in the steppe region round Ankara are injured each year by *Hyponomeuta* spp. The district is not very rich in fruit trees, but willows abound along the small rivers and are heavily infested by the larvae, which cause annoyance to the townspeople, who resort to the valleys. From the willows, the moths pass to fruit trees, especially apple and pear. In years in which the moths are plentiful, the willows are lopped in order to destroy the eggs, which are laid on the thin branches, but this deprives the valleys of shade.

As little information is available regarding the effect of temperature and humidity on these Tineids, the author carried out laboratory experiments with *H. padellus*, L., from willow. The following is substantially his summary. The first-instar larvae cannot survive on withered branches, so that winter pruning of the willows can be an effective control measure. The number of eggs per mass ranged from 11 to 80, and averaged 37. Of 236 adults, about 30 per cent. were males. The moth has only one generation a year in nature, but larvae emerged from egg-masses deposited in the laboratory and kept at 25°C. [77°F.] and 80–85 per cent. relative humidity, and began to feed without having hibernated, though they died when the supply of fresh leaves ceased. This observation indicates that *H. padellus* can develop without a diapause if conditions are favourable. First-instar larvae developed in all combinations of relative humidities of from 45 to 100 per cent. and temperatures between 16 and 28°C. [60·8—82·4°F.]. High humidity and low temperature reduced the percentage mortality. The threshold of development was 7·4°C. [45·32°F.], and the temperature sum necessary for development to pupation was 532·4 day-degrees C. [958·32 F.]. No pupae survived at any humidity if the temperature was 36°C. [96·8°F.] or higher, or at 0–35 per cent. if it was 6°C. [42·8°F.]. The pupae developed, however, at 6°C. and higher humidities and at all combinations between 10–100 per cent. humidity and 12–28°C. [53·6–82·4°F.]. The average length of adult life varied with temperature and humidity from 3 to 25 days. It was shortened by high and low humidities combined with high and low temperatures, respectively. A comparison of the laboratory results with the average monthly temperatures and humidities indicates that the climate of Ankara is favourable to *H. padellus*.

Blunck (H.). **Schadbilder des Engerlings von** *Melolontha melolontha* **L. an landwirtschaftlichen und gärtnerischen Kulturpflanzen in Schleswig-Holstein.** [Types of Injury by the Larva of *M. melolontha* on Field and Garden cultivated Plants in Schleswig-Holstein.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 439–461, 23 figs., 3 pp. refs. Berlin, 1941.

The author describes and illustrates the numerous types of injury done by larvae of *Melolontha melolontha*, L., to field and garden crops in Schleswig-Holstein, supplementing his own observations by references to the European literature.

Fulmek (L.). **Die eigentlichen Gefahren der San José-Schildlaus in der Ostmark.** [The particular Danger of the San José Scale in Austria.]—*Z. angew. Ent.* **28** pt. 2–3 pp. 462–465. Berlin, 1941.

The author considers that the danger to fruit trees in Austria resulting from the establishment in Europe of *Aspidiotus perniciosus*, Comst., has not been sufficiently stressed. The feeding punctures made by this Coccid cause the formation of red spots on the fruit, the smooth bark and even the leaves, and a tree would be killed by the after effects of severe infestation even if it could be freed from the Coccid. Heavily infested trees should be removed and burnt by early May at the latest, before the young larvae become active. The fecundity of this Coccid is not so great as it is in California, but it has at least two generations a year, as compared with the single one of the indigenous species, and in favourable years may produce at least a partial third. In Austria, it reaches its limits of distribution in Europe, for it occurs only in the warm, low-lying districts where grape-vines are cultivated [*cf. R.A.E.*, A **26** 663]. The heaviest infestations occur in private gardens, where fruit trees and bushes are crowded, and not in commercial orchards. The chief injury is to currants, apple and pear. Stone fruit is less heavily infested, but some damage is caused to peach.

Of the indigenous Coccids that infest fruit trees in Austria, *Lepidosaphes ulmi*, L., is the least sensitive to cold and survives in the most exposed situations. Next come *Aspidiotus ostreaeformis*, Curt., and *A. pyri*, Licht., of which the latter is predominant. The most warmth is required by *Epidiaspis leperii*, Sign., and *A. perniciosus*, which occur together, and of which the former is the most harmful of the indigenous species.

Mineral-oil and tar-oil emulsions have proved more effective than lime-sulphur against *A. perniciosus*, but as total eradication is difficult to achieve, the population should be kept as low as possible by means of repeated winter treatment [*cf. loc. cit.*].

Zacher (F.). **Beobachtungen über "Kornmotten."** ["Observations on "Grain Moths."]—*Z. angew. Ent.* **28** pt. 2–3 pp. 466–476, 8 figs., 16 refs. Berlin, 1941.

The author reviews the history of the original descriptions of *Tinea granella*, L., *T. personella*, Pierce & Metcalf, *T. secalella*, Zacher, and *T. cloacella*, Haw., which infest stored grain in Germany, and gives keys to them based on the genitalia of each sex. Definite records of the first three of these species in Europe are noted, with locality and date. A female of *T. granella* laid 160 eggs in 3 days, while females of

T. secalella laid from 83 to 150. Characters distinguishing the eggs of these two species are described. Eggs of *T. granella* hatched in 12–13 days at 17–18·3°C. [62·6–64·94°F.] and those of *T. secalella* in 12–13 days at 18·7–19·9°C. [65·66–67·82°F.] and 5–6 at 25·9°C. [78–62°F.]. *T. granella* appears to have two, sometimes overlapping, generations a year, with flight periods from January to June and in August–September, but the summer generation does not always develop in northern Germany. *T. secalella* has three generations a year in northern Germany, with flight periods in March–June, July–August, and September. The author bred *Meteorus pulchricornis*, Wesm., from *T. secalella* in dried fungi and *Angitia fenestralis*, Hlmgr., from stored rye infested by *T. secalella* and *Ephestia elutella*, Hb. *A. fenestralis* had previously been known as a parasite of *Plutella maculipennis*, Curt. A questionnaire sent to all parts of Germany gave rather negative results regarding *Tinea* spp., but numerous samples of *E. elutella*, and *Plodia interpunctella*, Hb., and some of *E. cautella* and *Aphomia* (*Paralispa*) *gularis*, Zell., were received from grain warehouses.

Chapman (A. J.) & Lowry (W. L.). **Control of the Pink Bollworm with Insecticides.**—*J. econ. Ent.* **34** no. 4 pp. 490–492, 2 refs. Menasha, Wis., 1941.

In laboratory and field tests of sprays and dusts carried out in the Presidio Valley, Texas, from 1933 to 1939, against *Platyedra* (*Pectinophora*) *gossypiella*, Saund., on cotton, fluorine compounds, particularly cryolite, and fixed nicotines gave the best and most consistent results; derris dusts were effective in the laboratory but gave poor control in the field. In 1940, dusts of cryolite (85 per cent. sodium fluoaluminate), basic copper arsenate and cuprous cyanide and a spray containing 50 lb. cryolite, 50 U.S. gals. light oil and 50 U.S. gals. water, applied six times at intervals of four days, caused 53·4, 28·4, 47·7 and 59·6 per cent. reduction in the number of larvae per boll in field plots. Nicotine sulphate and light petroleum oils gave some control of the eggs in the laboratory when used alone, but were more effective when combined; a spray of 2 pints nicotine sulphate, 50 gals. miscible oil and 50 gals. water, which gave 97·3 per cent. reduction in hatch, was the best of those tested. Older eggs appeared to be slightly more susceptible than newly deposited ones.

Chapman (A. J.) & Hughs (M. H.). **Factors influencing the Formation of resting Pink Bollworm Larvae.**—*J. econ. Ent.* **34** no. 4 pp. 493–494, 2 refs. Menasha, Wis., 1941.

Experiments were carried out in Texas in 1939–40 to determine some of the factors that tend to cause larvae of *Platyedra* (*Pectinophora*) *gossypiella*, Saund., to enter the resting (overwintering) stage instead of pupating, and particularly the importance of the age of the cotton bolls on which the larvae feed [*cf. R.A. E.*, A **28** 532]. The tests involved larvae overwintering in the bolls and also those overwintering in cocoons in or on the soil. The results indicate that the age of the boll is an important factor, since about 13, 27 and 94 per cent. of the larvae entered the resting stage in bolls 20, 30 and 40 days old that were artificially infested with eggs between 2nd August and 3rd September, and about 26, 43 and 89 per cent. in similar bolls infested between 22nd September and 1st October. The higher percentages in the second

set of bolls were probably due to the lower temperatures. Of mature larvae that were released on irrigated and non-irrigated soil in the first and second halves of September and October, when the mean temperatures were about 82, 76, 72 and 68°F., 1·7, 31·3, 54·8 and 66·8 per cent., respectively, entered the resting stage. Among those released in September, these percentages were significantly higher on dry soil than on irrigated soil, but there was no significant difference among those released in October, which indicates that the effect of moisture in stimulating pupation was offset by the lower temperatures. It is concluded that early maturity of the cotton crop and early cleaning of the fields is of importance in reducing the number of larvae that overwinter.

GAINES (R. C.), YOUNG (M. T.) & GARRISON (G. L.). **Effect of different Calcium Arsenates upon Boll Weevils, Cotton Aphids, and Plant Bugs, and upon Yields.**—*J. econ. Ent.* **34** no. 4 pp. 495–497, 5 refs. Menasha, Wis., 1941.

Experiments on the control of *Anthonomus grandis*, Boh., and other cotton pests with calcium-arsenate dusts containing various percentages of water-soluble arsenic pentoxide [*cf. R.A.E.*, A **28** 474; **29** 257, 359] were continued in Louisiana in 1940 with compounds containing 0·42, 11·4 and 16·5 per cent. water-soluble arsenic pentoxide, as determined by the New York method, and having average particle sizes of 1·0, 1·3 and 3·1 microns, as measured by the air-permeation method, respectively. Five effective applications were made at approximately 5-day intervals between 26th July and 21st August on one plot and between 3rd and 30th August on another, and records were made of infestation by *A. grandis*, *Aphis gossypii*, Glov., and the Capsids, *Lygus oblineatus*, Say, and *Adelphocoris rapidus*, Say, and of the yield of seed cotton. The results obtained were very variable, but in both experiments the three calcium arsenates were equally effective against *Anthonomus grandis* and resulted in equal yields, and those containing the higher percentages of water-soluble arsenic pentoxide caused greater increases in infestation by *Aphis gossypii* and greater reductions in that by the two Capsids than the calcium arsenate containing only 0·42 per cent.; no significant decreases in the numbers of adult Capsids were obtained. The average increases in seed cotton were 239, 220 and 247 lb. per acre on plots treated with calcium arsenate containing 0·42, 11·4 and 16·5 per cent. water-soluble arsenic pentoxide.

In cage tests, there was no significant difference between the mortalities of *Anthonomus grandis* given by calcium arsenates containing 11·4 and 16·5 per cent. water-soluble arsenic pentoxide, but both caused significantly higher mortalities than that containing 0·42 per cent.

EWING (K. P.). **Spraying versus Dusting for Boll Weevil Control.**—*J. econ. Ent.* **34** no. 4 pp. 498–500, 1 graph. Menasha, Wis., 1941.

Since unfavourable conditions for applying dusts, such as high winds and lack of dew, sometimes prevail in central Texas when insects are causing critical damage to cotton, the relative merits of sprays and dusts for the control of the boll weevil [*Anthonomus grandis*, Boh.]

were compared in 1939 and 1940. In 1939, when only 18·8 per cent. of the squares were punctured in the untreated plots, three effective applications between 1st and 27th July of a dust of calcium arsenate and a spray of lead arsenate reduced the infestation to 11·3 and 15·9 per cent., respectively, the corresponding increases in yield being 6 and 30 per cent. In 1940, when the average infestation in the control plots was 55·4 per cent., infestation averaged 8·7, 32·5 and 42·1 per cent. in plots receiving five applications between 9th and 31st July of a dust and a spray of calcium arsenate and a spray of lead arsenate, respectively, and the corresponding increases in yield were 83·2, 20 and 1·6 per cent. The calcium arsenate contained 0·75 per cent. water-soluble arsenic pentoxide, as determined by the New York method, and 40·1 per cent. total arsenic pentoxide, and was applied at the rate of 7–8 lb. per acre, and the lead arsenate contained 0·18 per cent. water-soluble arsenic pentoxide by the A.O.A.C. method and 31·1 per cent. total arsenic pentoxide, and was applied at the rate of 2–5 lb. per acre ; both materials had a mean surface particle diameter of less than 1 micron, as determined by air permeation.

Although lead arsenate sprays resulted in slightly more yield than calcium arsenate dusts under conditions of light infestation, the dust gave much better control than either arsenate in sprays under conditions of heavy infestation, and resulted in larger gains in seed cotton and greater profits.

McGarr (R. L.). **Cryolite and Cryolite-sulfur Mixtures for Boll Weevil Control and their Effect on the Cotton Aphid.**—*J. econ. Ent.* **34** no. 4 pp. 500–501, 1 graph. Menasha, Wis., 1941.

The author describes dusting experiments, carried out in Mississippi in 1940, in which synthetic cryolite, alone and in two commercial mixtures with sulphur, was compared with calcium arsenate for the control of *Anthonomus grandis*, Boh., and for its effect on *Aphis gossypii*, Glov., on cotton. The arsenate was applied at the rate of 6 lb. and the others at about 10–12 lb. per acre ; five effective applications were made between 27th July and 24th August. The mixture containing 29·7 per cent. sodium fluoaluminate gave no control of *Anthonomus*, and the one containing 34·6 per cent. reduced the average seasonal infestation to 42·5 per cent., as compared with 48·4 in the control ; cryolite alone (89·4 per cent. sodium fluoaluminate) reduced it to 27·7, and calcium arsenate to 15·3 per cent. The average number of Aphids per sq. in. leaf area in the control plot was 0·37 ; the averages increased in proportion to the content of sodium fluoaluminate where the mixtures of cryolite and sulphur were applied (0·82 and 1·01 per sq. in.), and to 2·63 and 3·93, respectively, where cryolite alone and calcium arsenate were used.

Gaines (R. C.). **Effect of Boll Weevil Control and Cotton Aphid Control on Yield as shown in a factorial Experiment.**—*J. econ. Ent.* **34** no. 4 pp. 501–504, 1 ref. Menasha, Wis., 1941.

In 1940, factorial experiments to determine the effect on infestation and yield of cotton of treatment with calcium-arsenate dust containing about 7–8 per cent. water-soluble arsenic pentoxide, for the control

of *Anthonomus grandis*, Boh., and with a dust of nicotine sulphate and lime containing 3 per cent. nicotine against *Aphis gossypii*, Glov., and of a combination of the two treatments [*cf. R.A.E.*, A **29** 359] were continued in Louisiana, in South Carolina and at two localities in Texas. Applications of calcium arsenate at the rate of about 7 lb. per acre were begun when the first blooms appeared on the cotton plants and repeated at 5-day intervals ; 11 effective applications were made at College Station, Texas, and eight at the other localities. Nicotine dust was applied at 2–4 times at a rate of approximately 14 lb. per acre.

Calcium arsenate alone caused significant reductions in infestation by *Anthonomus* in all localities but the one in South Carolina, and significant increases in the numbers of Aphids and increased yields in all localities, the last being significant only in Louisiana and at College Station. Nicotine dust did not affect either infestation by *A. grandis* or yield at any locality when used alone, but caused significant reductions in Aphids in all localities except in South Carolina, both when used alone and with calcium arsenate. The combined treatment reduced infestation by *A. grandis* significantly in all localities except South Carolina, and resulted in yields 205, 95 and 80 lb. seed cotton per acre greater than those from calcium arsenate alone in Louisiana and South Carolina and at College Station, but 20 lb. per acre less at Waco, Texas ; only the first difference was significant. The relation between the reductions in Aphid population and the increases in yield, which appear to be inconsistent, are discussed.

GAINES (J. C.). **Tests of Insecticides for Boll Weevil Control during 1940.**—*J. econ. Ent.* **34** no. 4 pp. 505–507, 1 ref. Menasha, Wis., 1941.

The results are given of tests in which calcium arsenate containing 19 per cent. water-soluble arsenic pentoxide and having a mean surface diameter of 3·5 microns was compared with commercial calcium arsenate (7·3 and 7·7 per cent. water-soluble arsenic pentoxide) and a mixture of synthetic cryolite and sulphur (85 : 15) containing 73·2 per cent. sodium fluoaluminate for the control of *Anthonomus grandis*, Boh., on cotton in Texas and Louisiana [*cf. R.A.E.*, A **29** 257]. The effect of the treatments on Aphids [*Aphis gossypii*, Glov.] and the Capsids, *Lygus oblineatus*, Say, and *Adelphocoris rapidus*, Say, was observed. The dusts were applied at the rate of from 7·2 to 10 lb. per acre at approximately 5-day intervals.

The calcium arsenates were equally effective in controlling *Anthonomus* and increasing yield in both places, though the increase in Aphid population was greater on plots treated with the special calcium arsenate. They gave significantly better control of *Anthonomus* and significantly higher yields than the cryolite mixture, and all the insecticides gave significant control and significantly higher yields than were obtained on the untreated plots. The Capsid population was low in Louisiana and caused little damage, but the control was significantly better on the plots treated with special calcium arsenate than on those treated with the cryolite mixture, and better than on those treated with commercial calcium arsenate, though the difference was not significant ; the population was too low in Texas for records to be taken.

Moreland (R. W.), Ivy (E. E.) & Ewing (K. P.). **Insecticide Tests on the Bollworm, Boll Weevil, and Cotton Leaf Worm in 1940.**—*J. econ. Ent.* **34** no. 4 pp. 508–511, 1 fig., 1 ref. Menasha, Wis., 1941.

The authors give details of cage tests in Texas in 1940 in which calcium arsenate was compared with a number of other insecticides against *Heliothis armigera*, Hb., and with basic copper arsenate against *Anthonomus grandis*, Boh., and *Alabama argillacea*, Hb. Each of a number of cotton plants growing in the field was dusted in the early morning, infested with five larvae of *H. armigera* in the second, third or fourth instars, ten weevils or ten third- or fourth-instar larvae of *A. argillacea*, and covered with a cage. After 120 hours, the percentage mortality of *H. armigera* was 62·3 for calcium arsenate, as compared with 91·8, 84, 87·9, 83·7 and 82·8 for mixtures of equal quantities of basic copper arsenate and hydrated lime or sulphur, lead arsenate, basic copper arsenate alone and cryolite containing 66·1 per cent. sodium fluoaluminate, respectively. The distribution and coverage of basic copper arsenate were unsatisfactory when it was used alone, but were improved when it was diluted with equal quantities of hydrated lime or micronised sulphur ; the sulphur mixture seemed to adhere to dry plants better than the lime mixture. Barium fluosilicate, two sodium fluosilicates and a mixture of calcium arsenate and Paris green were less effective than calcium arsenate alone. When the larvae were divided into four groups of different weight, it was found that, in general, mortalities due to insecticides varied inversely with the weight of the larvae ; the mixture of basic copper arsenate and lime was rather more effective than undiluted basic copper arsenate against all weight groups, and calcium arsenate was much less effective.

Basic copper arsenate, alone or with lime or, in a limited number of tests, with sulphur, gave higher and quicker kills of both *Alabama* and *Anthonomus* than calcium arsenate. Only the sodium fluosilicates caused any plant injury.

Gaines (J. C.). **A factorial Experiment comparing Insecticides for Control of Cotton Insects.**—*J. econ. Ent.* **34** no. 4 pp. 512–515, 7 refs. Menasha, Wis., 1941.

In Texas it is usual to treat cotton with contact insecticides early in the season to control *Psallus seriatus*, Reut., and with stomach poisons later against *Heliothis armigera*, Hb., and *Anthonomus grandis*, Boh., and the experiments described in this paper were carried out to obtain information on the value of insecticides used in a schedule of applications for the control of all cotton insects. All the dusts were applied in the early morning when the cotton was wet with dew, sulphur at the rate of 14·6 lb. per acre on 26th June and 9th July, and calcium arsenate, and mixtures of lead arsenate and clay (90 : 10) and natural cryolite and sulphur (85 : 15), at the average rate of 9·4 lb. per acre six times at approximately 5-day intervals from 24th July to 22nd August. The last three dusts contained 41·7 and 29·2 per cent. total arsenic pentoxide and 76·5 per cent. sodium fluoaluminate, respectively. Infestation by *A. grandis*, injury by *H. armigera*, populations of *P. seriatus*, *Adelphocoris rapidus*, Say, and *Aphis gossypii*, Glov., and yield of cotton were compared on plots receiving no treatment, sulphur, each of the three stomach poisons and sulphur followed by each stomach poison.

Sulphur reduced infestation by *P. seriatus*, but did not affect the yield. All the stomach poisons significantly decreased infestation by *Anthonomus* and *Adelphocoris* and injury due to *H. armigera*, and significantly increased the Aphid population and the yield; the cryolite and lead-arsenate mixtures were more effective against *H. armigera* than calcium arsenate, but less effective against *Adelphocoris*, and were followed by fewer Aphids. The arsenicals were more effective against *Anthonomus* than the cryolite mixture. On the basis of yield, all the stomach poisons were equally effective.

GAINES (J. C.). **Insecticide Tests for Bollworm Control during 1940.**—*J. econ. Ent.* **34** no. 4 pp. 515–518, 1 graph, 6 refs. Menasha, Wis., 1941.

The following is based on the author's summary of further tests of dusts for the control of *Heliothis armigera*, Hb., on cotton [*cf. R.A.E.*, A **29** 257], carried out in Texas in 1940. The experiments were designed to compare the effectiveness of commercial calcium arsenate, a special calcium arsenate containing a high percentage of water-soluble arsenic pentoxide and mixtures of synthetic or natural cryolite with sulphur (85 : 15) and of lead arsenate with clay (90 : 10). Records of the infestations of *Anthonomus grandis*, Boh., rapid plant bugs [*Adelphocoris rapidus*, Say] and Aphids [*Aphis gossypii*, Glov.] that developed on the plots made it possible to obtain some information on the action of the insecticides on these pests also. The lead-arsenate and natural-cryolite mixtures were more effective against *H. armigera* than the calcium arsenates or the synthetic-cryolite mixture. All arsenicals were more effective against *Anthonomus* than the cryolites; and those containing the highest percentage of water-soluble arsenic pentoxide caused the largest increases in Aphids, but gave the best control of *Adelphocoris*. In general, the plots treated with arsenicals yielded more cotton than those treated with cryolites, because the latter did not give adequate control of *Anthonomus*.

JANES (M. J.). **Control of the Flea Beetle, *Phyllotreta vittata discedens* Weise in the Texas Gulf Coast.**—*J. econ. Ent.* **34** no. 4 pp. 518–519, 1 ref. Menasha, Wis., 1941.

Phyllotreta vittata discedens, Weise, is a serious pest of mustard, turnips and similar crops in the Gulf Coast of Texas. Most of the injury is caused in April, May or June; in some cases, small seedlings are completely destroyed, and in others, numerous feeding punctures in the leaves result in a reduction of the market value of the mature plants. In experiments against the adults on mustard, a dust of cubé and sulphur (0·5 per cent. rotenone) gave significantly better control on the basis of injury per unit area of plant surface than one of pyrethrum and sulphur (0·1 per cent. pyrethrins) when both were applied five times at the rate of 30 lb. per acre in May 1939; there was no significant difference between the condition of the plants on the untreated plots and those dusted with pyrethrum and sulphur. In 1940, the infestation was so early and severe that many seedlings were completely destroyed, and the analysis of the comparative control was based on plant survival. Dusts of cubé and sulphur (0·55 per cent.

rotenone) and of concentrated pyrethrum dust and sulphur (0·1 per cent. pyrethrins), applied four times at the rate of approximately 25 lb. per acre, were equally effective, and control was significantly higher on the dusted plots than on the untreated ones.

ARANT (F. S.). **Rate of Application of Derris-talc Dusts for Pickleworm Control.**—*J. econ. Ent.* **34** no. 4 pp. 520–521, 1 ref. Menasha, Wis., 1941.

Further experiments were carried out in Alabama in 1940 on the control of *Diaphania nitidalis*, Stoll, on cantaloupe melons with dusts of derris and talc containing 1 per cent. rotenone [*cf.* *R.A.E.*, A **29** 404]. The cantaloupes were planted late in the season, as damage by this Pyralid is most severe during mid-summer; *D. hyalinata*, L., frequently causes serious damage in a late crop, but was not injurious in 1940. Five applications of a dust containing derris, talc and wheat flour (25 : 70 : 5 by weight) at the rate of 12·5, 20 and 27·5 lb. per acre followed by four at the rate of 17·5, 30 and 42·5 lb. per acre, at 4 7 day intervals from 22nd July to 29th August, gave 83·1, 92·3 and 94·2 per cent. control of *D. nitidalis*, respectively. It appeared that the lowest rate of application was rather less effective than the others and that the highest rate reduced the yield of melons slightly, but the differences were not significant. An average of 3,200 edible melons per acre was produced on plots dusted at the lowest rate, as compared with 96 on the control plots.

PIERCE (W. C.) & NICKELS (C. B.). **Control of Borers on recently top-worked Pecan Trees.**—*J. econ. Ent.* **34** no. 4 pp. 522–526, 3 figs., 3 refs. Menasha, Wis., 1941.

The results are given of observations in central Texas in 1932–39 on the bionomics and control of *Euzophera semifuneralis*, Wlk., and *Aegeria* (*Conopia*) *scitula*, Harr., which often cause severe injury to recently top-worked pecan trees; these are susceptible from the time the top is removed until the growth tissues of the scion and stock have united. The larvae of the two moths destroy the grafts by feeding on the cambium and callus of the scion and stock, which they attack through cracks in the grafting wax. A weak union often results from the feeding of the larvae, and wind may blow the scion from the tree. The larvae also destroy patch buds and girdle the basal portions of sprouts that have been previously patch-budded, so that they may be blown from the tree. Orchard practices that favour the development of the borers include the killing and felling of trees, the cutting back of branches on the trees before top-working, and the continuation of top-working operations in an orchard over a period of several years. One or more generations of both species may develop in stumps from felled trees and in girdles that are cut to kill trees.

Pupation and adult emergence of the overwintering generation of *E. semifuneralis* and emergence of adults of the first and second generations occurred in late March, April, late May and late June, respectively. Field observations indicated that this Pyralid has five generations a year under favourable conditions in central Texas. Adults of *A. scitula* emerged in April, May, July, August and

September ; little is known of its life-history, but only one generation a year is indicated in the literature. Mature larvae of both species have been taken in elm and oaks as well as pecan in Texas.

Brushing a solution of 1 lb. paradichlorobenzene in 2 U.S. quarts crude cottonseed oil over infested areas in bark wounds on the trunks of pecan trees gave effective control of larvae of both species in shallow burrows, but was less effective against those feeding in burrows that extended several inches beyond the point of entrance. The best method of protecting scions from borer injury was to cover all graft wounds with a grafting wax that would not crack until after the graft had formed a good union ; the inclusion of paradichlorobenzene in the wax mixtures did not increase their effectiveness.

REINHARD (H. J.). **The Life History of *Phyllophaga tristis* (F.) and allied Forms.**—*J. econ. Ent.* **34** no. 4 pp. 526–532, 4 refs. Menasha, Wis., 1941.

An account is given of laboratory studies in Texas, carried out on the same lines as those of other species of *Lachnosterna* (*Phyllophaga*) [*cf. R.A.E.*, A **29** 213], of the bionomics of three subspecies of *L.* (*P.*) *tristis*, F., the typical one, *amplicornis*, Reinhard, and *apicata*, Reinhard, all of which have a life-cycle of one year. The adults of all three feed on oak, pecan and elm ; little is known of the habits and economic importance of the larvae. Notes on their distribution in Texas are included.

MUNDINGER (F. G.). **Two Buprestid Cane-borers of Brambles with Experiments on Control.**—*J. econ. Ent.* **34** no. 4 pp. 532–537, 4 figs. Menasha, Wis., 1941.

The adults and larvae of two Buprestids that bore in the canes of brambles in New York State, *Agrilus ruficollis*, F., and *A. rubicola*, Abeille, are described, and an account is given of their bionomics and control. *A. ruficollis* was known to attack raspberry and blackberry, and all the characteristic cane injury was formerly attributed to this species ; in 1938, however, it was found that both larvae and adults of *A. rubicola*, which was bred in considerable numbers from raspberry canes, caused injury indistinguishable from that due to *A. ruficollis*, and that the life-history and habits of the two species were almost identical. The adults feed on the upper leaf surfaces, making irregular holes, and the larvae bore in the new growth of the canes [*cf. R.A.E.*, A **30** 55], forming galls and causing the foliage to wilt and die and the canes to snap off. Rose stems showing malformation typical of injury by *A. ruficollis* were also found to be infested by *A. rubicola*. In 1938, the adults emerged between late May and late July, during the period of fruit formation and harvesting, and were found in the fields until late August. Oviposition continued until late July, the females feeding for several days before laying eggs. In cages the beetles survived for up to 36 days, and the egg stage lasted 4–24 days, depending on temperature ; the pupal stage lasted 20–39 days. The method of oviposition and the development and feeding of the larvae are described [*cf. loc. cit.*]. During some seasons, mortality of the larvae, particularly those of *A. rubicola*, is relatively high, owing largely to parasitism by *Tetrastichus rugglesi*, Rohw., and also, apparently, to fungous diseases. The usual control measure is the destruction of infested canes, and in 1938–40 one or two applications of sprays and dusts containing lead

arsenate or ground derris and sprays of cryolite gave good control of the adults. Two applications of lead arsenate were very effective, but since the second injured the foliage, was dangerous to bees and might cause objectionable residues on the fruit at harvest, it was replaced after the first year by a spray containing ground derris. The author considers that the most promising schedule was one in which a spray of 5 lb. lead arsenate and ½ lb. skim milk powder in 100 U.S. gals. water, applied thoroughly to the foliage and wild brambles just before bloom, was followed about two weeks later by one in which the same quantity of ground derris root (containing 5 per cent. rotenone) was substituted for the lead arsenate, and this schedule gave satisfactory results in commercial plantings during 1939 and 1940. In a very wet season a third spray may be advisable. It is doubtful whether a severe infestation can be eradicated in a single year.

MITCHENER (A. V.). **Sawdusts in Grasshopper Bait.**—*J. econ. Ent.* **34** no. 4 pp. 538–540, 1 ref. Menasha, Wis., 1941.

Experiments carried out in Manitoba with poisoned baits against nymphs of *Camnula pellucida*, Scud., and *Melanoplus bivittatus*, Say, in 1935 and against adults of *M. mexicanus*, Sauss., in 1937 showed that the baits did not attract different species equally, that sawdusts from different trees were not equally useful in baits and that sawdust alone was not an effective carrier in baits for any of the species tested. The grasshoppers were provided with fresh wheat or barley plants for at least 24 hours before the baits were given and throughout the experiments. The baits contained sodium arsenite at the rate of 2 lb. As_2O_3 per 100 lb. carrier, with enough water to moisten the bait. Of the species tested, *C. pellucida* was killed most readily with poison baits. Excellent results were obtained when the carrier was finely cut green barley plants or equal volumes of bran and sawdust from spruce [*Picea*] or poplar [*Populus*] ; the effectiveness decreased when sawdust from Jack pine [*Pinus banksiana*] was used. They were killed to a limited extent when pure sawdust, particularly poplar sawdust, was used as a carrier. Finely cut green wheat plants were very effective as a carrier for the poison in the single trial in which they were used against *M. bivittatus* ; equal volumes of bran and poplar sawdust were less effective, and very poor results were obtained with any sawdust alone. The baits used were much less effective against *M. mexicanus* ; both bran and green wheat plants were unsatisfactory as carriers, and sawdust alone was not attractive.

KAGAN (A.) & FENTON (F. A.). **Effect of dormant Oil Sprays on the Eggs of *Stictocephala inermis* (Fab.), an Elm-infesting Treehopper.**—*J. econ. Ent.* **34** no. 4 pp. 541–542, 7 refs. Menasha, Wis., 1941.

Experiments were carried out in Oklahoma during the winter of 1938–39 on the use of dormant oil sprays on American elm (*Ulmus americana*) and Asiatic elm (*U. pumila*) against the eggs of *Stictocephala inermis*, F. This Membracid had occurred in unusual numbers and caused severe injury to young elms during the preceding summer. The trees were sprayed with Dendrol, containing approximately 93 per cent. oil, or Spra-mulsion, containing approximately 95 per cent. oil, at dilutions of 2, 4, 6 or 8 per cent. on 4th December, 3rd March or 22nd March, when the temperatures were 49–58, 59–61, and 65–66°F., respectively ; the relative humidity was 24–58 per cent. on each day.

On American elm, the mean control obtained from all the oil sprays applied on the three dates was 15·2, 19·4 and 44 per cent., respectively. Both materials were most effective at dilutions of 6 per cent., the last application of each giving 63·1 and 56·6 per cent. control, respectively. The sprays were more effective on Asiatic elm, and there was no significant difference in kill from those applied on the three dates. The mean control for all applications was highest (68·7 per cent.) when 6 per cent. Spra-mulsion was used, but 4 per cent. was almost as effective (58·1 per cent.) and, on a basis of costs, the most efficient. Data on the effect of the percentage of oil in the spray on the control are conflicting, but, in general, it appears that dormant sprays are unsatisfactory against *S. inermis* on elm. Lime-sulphur (4–5° Bé) was completely ineffective.

Rankin (W. H.), Parker (K. G.) & Collins (D. L.). **Dutch Elm Disease Fungus prevalent in Bark Beetle infested Elm Wood.**—*J. econ. Ent.* **34** no. 4 pp. 548–551, 1 ref. Menasha, Wis., 1941.

The results of some of these investigations to determine the frequency of occurrence of *Ophiostoma* (*Ceratostomella*) *ulmi*, the fungus that causes Dutch elm disease, as a saprophyte associated with *Scolytus multistriatus*, Marsh., in dead elm wood of all types, for which a series of samples was collected in New York State during the winter of 1939–40, have already been noticed from an abstract [*R.A.E.*, A **29** 502]. The tests were duplicated with samples containing the summer larvae of *S. multistriatus* and *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh. From Westchester County, where the average number of diseased elms declined in eight years from eight or ten to less than one per square mile, 24 per cent. of the samples that contained either *S. multistriatus* alone or both species, and 20 per cent. of these containing only *H. rufipes*, yielded beetles carrying the fungus. From Broome County, where there was probably about one diseased tree per 5–10 square miles, and where *S. multistriatus* has not been found, 25 per cent. of 16 infested samples yielded adults of *H. rufipes* carrying the fungus.

It is concluded that the saprophytic existence of the fungus is neither a newly acquired habit nor a temporary one dependent for its continuation on the parasitic phase, and that the fungus advances into new territory in the saprophytic stage, attacking living elms only when it has attained a sufficient concentration in infested wood.

Albrecht (H. R.) & Chamberlain (T. R.). **Instability of Resistance to Aphids in some Strains of Alfalfa.**—*J. econ. Ent.* **34** no. 4 pp. 551–554, 1 ref. Menasha, Wis., 1941.

The authors describe experiments in which plants of lucerne found to be resistant to attack by *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) [*R.A.E.*, A **22** 294] were crossed with commercial varieties, to determine whether the resistant character could be transmitted by hybridisation. It was found, however, that the resistance as it occurred in the plants studied was not a stable character, since hybrids that would not support the development of Aphids in the seedling stage became capable of supporting an abundant population a year later, though it is possible that the resistant character would be manifest under all conditions to which the plants would normally be subject in the field. It was considered impracticable to determine the precise manner of the

inheritance of the resistant character until the relation of environment to the expression of resistance to Aphids, the determination of which involves experimental difficulties, is better known; the work was therefore discontinued.

MARTIN (C. H.) & HOUSER (J. S.). **Numbers of *Heliothis armigera* (Hbn.) and two other Moths captured at Light Traps.**—*J. econ. Ent.* **34** no. 4 pp. 555–559, 1 fig., 4 refs. Menasha, Wis., 1941.

The results are given of experiments carried out in 1938 and 1939 in Ohio to compare the attractiveness to adults of *Heliothis armigera*, Hb., of electric lights, including incandescent, mercury vapour and fluorescent lamps, that ranged over a wide scale of brilliance and differed in spectral distribution; records for *Cirphis unipuncta*, Haw., and *Protoparce sexta*, Joh., obtained in 1939, are included. There were many nights on which *H. armigera* did not come to the light-traps, even when it was present in the field, and there was no sharp difference in response to the various lights; many individuals flew straight into the lights, but others rested on neighbouring plants and sometimes oviposited before completing their flight.

In 1938, when traps containing five different lamps were operated in tomato fields, 100-watt mercury vapour lamps, with a brightness of 3,400 lumens, attracted three or four times as many moths as a 15-watt fluorescent lamp or a 150-watt incandescent lamp (270 and 2,610 lumens, respectively), though daily records showed that on several nights the number of moths caught at the fluorescent light equalled or exceeded the number caught at the mercury vapour light, and the incandescent light was no more attractive than the fluorescent one. A mercury vapour lamp that emitted ultraviolet light did not attract significantly more moths than one of equal intensity and approximately the same spectral quality that did not.

In 1939, when 10 lamps were compared in traps in fields of tomato and sweet maize, a 1,000-watt mercury vapour lamp with an intensity of 65,000 lumens did not appear to be any more attractive to *H. armigera* and *C. unipuncta* than three 1,000-watt incandescent lamps (62,000 lumens) or much more attractive than a blue fluorescent lamp giving 2,300 lumens or a 100-watt mercury vapour lamp giving 3,400 lumens, but it was the most attractive to *P. sexta*. The 1,000-watt mercury vapour light attracted more insects in general than the 100-watt mercury vapour light or a cluster of five 20-watt blue fluorescent lamps.

DITMAN (L. P.), GRAHAM (C.) & CORY (E. N.). **Pea Aphid Control in Maryland during 1940.**—*J. econ. Ent.* **34** no. 4 pp. 560–562. Menasha, Wis., 1941.

The results of investigations in 1940 on the control of the pea Aphid [*Macrosiphum onobrychis*, Boy.] on peas in Maryland by means of sprays and dusts of cubé and derris confirmed those obtained in the previous year [*cf. R.A.E.*, A **29** 202] and showed that fine grinding increases the effectiveness of both insecticides. All the treatments were applied on 28th May, and counts were made on 27th May and 1st June. A spray containing 3 U.S. pints nicotine sulphate and 3 lb. soap per 100

U.S. gals., applied at the rate of 150 U.S. gals. per acre and a pressure of 600 lb. and confined by a hood over the boom and a 25-ft. muslin trailer, was somewhat more effective, reducing the numbers of Aphids by about 92 per cent., and nicotine applied with a vaporiser gave the highest mortality of all (approximately 98 per cent. reduction).

WATKINS (T. C.). **Toxicities of Bordeaux Mixture, Pyrethrum and Derris, to Potato Leafhoppers.**—*J. econ. Ent.* **34** no. 4 pp. 562–565, 4 figs., 11 refs. Menasha, Wis., 1941.

The results are given of investigations carried out in New York to determine the toxicities of Bordeaux mixture and aqueous suspensions of ground pyrethrum flowers (0·92 per cent. total pyrethrins) and ground derris root (5·8 per cent. rotenone) to *Empoasca fabae*, Harr., by contact action under laboratory conditions, and to obtain direct comparisons of these toxicities at strengths used for spraying potatoes; the methods used are described. The leafhoppers were maintained on broad bean (*Vicia faba*), and adults 1–5 days old were used for immersion tests. Neither Bordeaux mixture nor derris showed any appreciable toxicity at concentrations 2–4 times as high as those generally used in the field, but a suspension containing the equivalent of ½ lb. pyrethrum (0·5 per cent. pyrethrins) per 100 U.S. gals., or only one-eighth of the concentration generally used for spraying, gave more than 90 per cent. mortality.

HUCKETT (H. C.). **Derris and the Control of the Mexican Bean Beetle.**—*J. econ. Ent.* **34** no. 4 pp. 566–571, 9 refs. Menasha, Wis., 1941.

The following is largely based on the author's introduction and summary. The efficiency of dusts and sprays containing rotenone in protecting bean plants from attack by *Epilachna varivestis*, Muls., has been diversely attributed to their toxic action by contact or when ingested and to their repellent properties. Detailed observations were therefore made under greenhouse conditions to determine the way in which derris sprays control larvae and adults, and particularly how they prevent immediate larval injury to the plants. Experiments with Bordeaux mixture were included. Tests under conditions of moisture and temperature considered favourable for the Coccinellid indicated that large percentages of larvae and adults were capable of surviving for five days in the presence of foliage sprayed with derris and that little if any feeding had taken place. Further tests indicated that the insect was capable of distinguishing between sprayed and unsprayed foliage and that the proximity of derris on the foliage had little if any effect in retarding feeding on unsprayed foliage. Supplementary tests confirmed that derris sprays are lethal when larvae and adults are directly hit in spraying; otherwise their effectiveness when applied as for purposes of ingestion was dependent on their repellent properties and, in the case of larvae, on desiccation as a result of unfavourable living conditions on the soil surface. The spray residue from Bordeaux mixture on foliage reduced the amount of feeding by both larvae and adults; when derris powder was added to Bordeaux mixture, it exerted a marked effect in protecting the foliage.

LANGE jr. (W. H.). **A Host Plant Record for the Weevil,** *Peritelopsis globiventris* **(Lec.).**—*J. econ. Ent.* **34** no. 4 p. 571, 2 refs. Menasha, Wis., 1941.

Peritelopsis globiventris, Lec., which was recorded as injuring globe artichoke (*Cynara scolymus*) in California in 1936 [*R.A.E.*, A **25** 249], has since been found in the same locality overwintering among the interfolded young leaves of this plant and feeding on them. Three adults emerged from the aerial parts of *Eriophyllum staechadifolium*, collected on 10th June 1940, and this appears to be a food-plant of the weevil, since it is common in the sand-dune areas of the coast and occurs near artichoke plantings in which damage has been observed.

HERVEY (G. E. R.). **Timing Cabbage Worm Treatments.**—*J. econ. Ent.* **34** no. 4 pp. 572–575, 3 figs., 1 ref. Menasha, Wis., 1941.

Experiments were carried out in western New York in 1939 and 1940 to determine the best timing for lead-arsenate sprays against larvae of *Pieris rapae*, L., and *Plusia* (*Autographa*) *brassicae*, Ril., on cabbage. The sprays contained 10 lb. lead arsenate and 6 oz. adhesive per 100 U.S. gals. water, and were applied at the rate of about 150 U.S. gals. per acre. Larvae of the second generation of *Pieris rapae* begin to attack cabbage about 15th–20th July, but are rarely numerous, and those of the third generation begin to appear during the first week in August and are usually active throughout the month. *Plusia brassicae* is rarely abundant before mid-August, but may continue to be destructive until late October. The chief damage by the two species is caused to young plants and mature heads, respectively. The sprays were applied on 19th or 24th July and 8th, 20th and 30th or 31st August to coincide as nearly as possible with the peaks in hatching of both species. The results were determined on the basis of yield of marketable cabbages and the degree of damage to the heads. The second application was the most effective single treatment and the first the least. The second and third formed the best combination of two applications and gave fair control of both species. At least three applications are necessary for maximum control, with a fourth in years of heavy infestation. When three treatments were applied, they were more effective when begun in August than when begun in July, but the plants are usually so large by the end of August that considerable mechanical injury is then caused by the sprayers. The bulk of the cabbage crop is closely trimmed at harvest in this area, eliminating the danger of objectionable residues. Cabbages planted late require fewer applications than those planted at the normal time, and the relative abundance of the insects is an important factor in determining the number of applications necessary to control them.

GOULD (E.) & GEISSLER (G. H.). **Codling Moth Emergence-activity Studies.**—*J. econ. Ent.* **34** no. 4 pp. 576–579, 7 graphs. Menasha, Wis., 1941.

An account is given of investigations in West Virginia in 1937–39 to determine the fluctuations in the population of the codling moth [*Cydia pomonella*, L.] and to correlate weather conditions and other factors with them. Records of emergence and activity were secured by

means of bait pails, dates of emergence and hibernation were determined by caging larvae, and records of entry into fruit were made by frequent examination of marked apples. Summarised results are given for each season, and the relations between adult activity, temperature and rainfall, and between adult activity and entry into the fruit are shown on graphs. It is concluded that the development of *C. pomonella* is materially affected by weather conditions, and that the seasonal fluctuation in moth population is determined almost entirely by them. Dense moth populations may produce only light infestations under adverse weather conditions such as frequently occur when adults of the overwintering generation are active.

McGarr (R. L.). **Control of the Cotton Aphid and the Boll Weevil in 1940.**—*J. econ. Ent.* **34** no. 4 pp. 580–582. Menasha, Wis., 1941.

In tests carried out in Mississippi in 1940, calcium arsenate and mixtures of equal quantities of calcium arsenate and sulphur, applied between 19th July and 2nd September for the control of *Anthonomus grandis*, Boh., on cotton caused significant increases in the population of *Aphis gossypii*, Glov. The addition of derris to the dusts to provide a rotenone content of about 0·5 per cent. kept the Aphid populations at approximately the same level as those in the untreated plots. There was practically no difference in Aphid control when the derris was mixed with regular or micronised (finely ground) calcium arsenate or when the derris and arsenate were mixed and then micronised. The addition to calcium arsenate of 0·5 or 1 per cent. nicotine or of tobacco dust to provide 0·15 per cent. nicotine did not prevent an increase of Aphids. The dusts of calcium arsenate or of calcium arsenate and sulphur to which derris had been added gave good control of *Anthonomus* and did not differ significantly from undiluted calcium arsenate under the conditions of light weevil infestation prevalent throughout the experiment.

Cody (C. E.). **Color Preference of the Pea Aphid in western Oregon.**—*J. econ. Ent.* **34** no. 4 p. 584. Menasha, Wis., 1941.

Counts of the numbers of *Macrosiphum onobrychis*, Boy. (*Illinoia pisi*, Kalt.) on each of 17 varieties of garden peas grown in adjacent plots in Oregon confirmed earlier observations that the Aphid prefers dark green varieties to light yellow-green ones [*cf. R.A.E.*, A **20** 284 ; **21** 515], the numbers of Aphids per plant tip averaging 17·38 on six light green varieties and 22·2 on 11 dark ones.

Knowlton (G. F.). **California Gull and Insect Control in Utah.**—*J. econ. Ent.* **34** no. 4 pp. 584–585. Menasha, Wis., 1941.

The author reports that during recent serious outbreaks of grasshoppers and the Mormon cricket [*Anabrus simplex*, Hald.] in Utah, large numbers of *Larus californicus* have been observed every year feeding on these and other insects, including cutworms and white grubs [*Lachnosterna*], in various localities. It was estimated that this gull gave 90 per cent. control of grasshoppers after lucerne was harvested in one district in 1936.

Childs (L.). **An Aphid attacking Pears in the Pacific Northwest.**—*J. econ. Ent.* **34** no. 4 p. 585. Menasha, Wis., 1941.

An Aphid that has occasionally been observed feeding on pear trees, particularly of the Anjou variety, in Washington and Oregon during recent years, and with which yellow mottling and premature ripening of the fruit were associated, was collected on the leaves of trees bearing fruit in this condition in the late autumn of 1939 and identified as *Macrosiphum macrosiphum*, Wilson, a species originally described from *Amelanchier* in Oregon. During June 1940, it was found in several orchards feeding on the fruits of Anjou pears ; in orchards in which it was most prevalent, an abnormal premature fruit drop continuing into July was noticed. Both winged and wingless forms were present in June. Recent field observations indicate that the attack by this Aphid causes premature ripening of Bartlett pears. Complete control was obtained in the spring of 1941 by the use of oil (3 per cent.) with a late dormant application of lime-sulphur and also nicotine sulphate similarly applied.

Scott jr. (D. B.). *Brachyrinus sulcatus* **Fab. in southern California.**—*J. econ. Ent.* **34** no. 4 p. 587, 4 refs. Menasha, Wis., 1941.

Otiorrhynchus (*Brachyrrhinus*) *sulcatus*, F., has recently attacked camellias, azaleas and occasionally rhododendrons and yews in nurseries in southern California. The older larvae partly or completely girdle the trunks of camellias and azaleas just below the surface of the soil, plants as much as three years old, or more in the case of azaleas, being readily killed. Pupation and maximum emergence of the overwintered generation occur about the middle of April and in May, respectively, and the adults begin feeding at night on the upper foliage of the plants immediately after emergence. Fluosilicate baits [*cf. R.A.E.*, A **24** 385] proved ineffective against *O. sulcatus* in southern California, and sprays of natural cryolite, which are effective against *O.* (*B.*) *cribricollis*, Gylh., were tested and were found to give complete mortality after 36 hours ; very few of the weevils died during the first 24 hours.

Dunnam (E. W.) & Clark (J. C.). **Cotton Aphid Multiplication following Treatment with Calcium Arsenate.**—*J. econ. Ent.* **34** no. 4 pp. 587–588, 1 ref. Menasha, Wis., 1941.

The results of preliminary studies on the factors that cause the increase of *Aphis gossypii*, Glov., on cotton after dusting with calcium arsenate, carried out in Mississippi in 1938, when the numbers of parasites and predators present were insignificant, indicated that some of the insecticide was taken up by the leaves and some by the root system. The pH of the soil, and probably also that of the leaf cell sap, was increased in the plots of cotton dusted with calcium arsenate, and earlier maturity of the plants and shedding of leaves was associated with the increase. It was considered that the arsenic stimulated Aphid reproduction and caused the shorter pre-reproductive period, the greater number of young born daily and the larger total number of young per Aphid observed on the dusted plants.

Further work showed that the pH of the cell sap in the leaves was consistently higher in plants dusted with calcium arsenate than in

the control plants ; that Aphids multiplied more rapidly when caged on cotton leaves dusted with calcium arsenate containing 0·7 per cent. water-soluble arsenic pentoxide, as determined by the New York method, than when caged on untreated leaves, and even more rapidly on leaves dusted with calcium arsenate containing 13·9 per cent. water-soluble arsenic pentoxide [*cf. R.A.E.*, A **29** 359]. On cotton dusted with hydrated lime, Aphids reproduced slightly faster than on the control plants, indicating that, though the amount of water-soluble arsenic was the most important factor, the hydrated lime in the calcium arsenate also contributed to the increase in Aphids. In 1939, cotton plants were sprayed and dusted with a number of substances with different pH values (from 2·16 to 11·8), in an effort to find a material that could be used with commercial calcium arsenate to act as a buffer for the water-soluble arsenic pentoxide, reduce the alkalinity and permit the cotton plant to overcome any possible injury caused by the remaining water-soluble arsenic pentoxide. The Aphid population was relatively low in all plots, but plants dusted with zinc arsenate, with a pH of 6·4, had fewer Aphids, appeared in better condition at the end of the summer and produced higher yields than those treated with the other materials. It is considered, therefore, that zinc salts would probably be the most suitable materials for use with calcium arsenate for the control of cotton pests.

DOUCETTE (C. F.). *Eucordylea huntella* **Keifer as a Pest of Rhododendron.**—*J. econ. Ent.* **34** no. 4 pp. 588–589, 1 fig., 1 ref. Menasha, Wis., 1941.

Buds of native rhododendron (*Rhododendron californicum*) injured by larvae of the Tineid, *Eucordylea huntella*, Keifer, were found in various places in the coastal area of southern Oregon in spring in 1939 and 1940. From 10 to 40 per cent. of the flower buds on the various plants examined had been attacked, but no injury was found on native azaleas [*cf. R.A.E.*, A **25** 375]. Adult emergence from buds collected in March 1940 and kept under room conditions continued from 2nd April until 17th May ; pupation took place within the buds. A number of infested flower buds were found in September 1940 ; the larvae were very small, and many of the infested buds failed to open in the following spring.

Parasitism appeared to be heavy. *Copidosoma nanellae*, Silv., the adults of which emerged in May and June, was very abundant in both years ; a single individual of *Pimpla* (*Epiurus*) sp. emerged in 1939, and one individual of *Apanteles* sp. and numbers of *Eubadizon* sp. and a Tachinid (*Lispidea* sp.) were bred in 1940.

MILLS (H. B.). **The Effect of Tillage on Grasshopper Eggs.**—*J. econ. Ent.* **34** no. 4 p. 589. Menasha, Wis., 1941.

Investigations to determine the effect of different methods of cultivation on the hatching of eggs of *Melanoplus mexicanus*, Sauss., carried out in 1939 in north-eastern Montana, where infestation was extremely intense and the hatch remarkably uniform [*cf. R.A.E.*, A **29** 536], showed that idle land seems to become progressively less attractive to ovipositing females ; that any procedure that stirs up the soil reduces the survival of the eggs ; that double disking is

considerably better than a single treatment ; and that ploughing is by far the best treatment for the destruction of the eggs in the soil. When the soil contains a sufficient number of eggs to produce a large population, stubbling-in grain without previous soil treatment is a dangerous practice.

Smith (C. F.). **Control Studies of the Woolly Apple Aphid.**—*J. econ. Ent.* **34** no. 4 p. 590, 1 ref. Menasha, Wis., 1941.

In experiments carried out in 1939 and 1940 on the control of *Eriosoma lanigerum*, Hsm., on the roots of young apple trees in North Carolina, a solution of sodium cyanide in slightly alkaline water, poured round the base of the trees and covered with a little soil, gave satisfactory control without injuring the trees. The acid in the soil neutralised the alkali of the solution and released hydrocyanic acid gas. All the Aphids were killed on the roots of approximately 95 per cent. of the trees treated with 0·2–1 gm. sodium cyanide in 1 U.S. quart alkaline water per tree. Injury to the tree occurred when more than 1 gm. sodium cyanide was used per tree or when 1 gm. was used in less than 1 U.S. quart water. Fair, but less consistent control was obtained with carbon-bisulphide emulsion (1 : 1,600) or dichlorethyl-ether solution (1 : 800) [*cf. R.A.E.*, A **29** 299], used at the rate of 2 U.S. quarts per tree, but some trees were injured.

Essig (E. O.). **Two little known Scale Insects.**—*J. econ. Ent.* **34** no. 4 p. 590, 5 refs. Menasha, Wis., 1941.

Lecanium kunoense, Kuw., was found in considerable numbers on one- and two-year-old wood of apple in April 1941, and *Chionaspis etrusca*, Leon., was taken on *Tamarix* sp. in June, both in California. *C. etrusca* appears to limit its feeding wholly to species of *Tamarix* ; it also occurs in Arizona and Texas.

Smith (C. F.). *Trichogramma* **and the Oriental Fruit Moth.**—*J. econ. Ent.* **34** no. 4 p. 590. Menasha, Wis., 1941.

In limited tests carried out in North Carolina in 1940 on 25 peach trees lightly infested with the oriental fruit moth [*Cydia molesta*, Busck], the liberation of the Georgian strain of *Trichogramma minutum*, Ril. [*cf. R.A.E.*, A **29** 192] at the rate of 5,000 per tree, eight times at approximately weekly intervals from the end of June to early August, had no effect on the infestation, as shown by bait traps, and it is concluded that the parasite is of no value in controlling a light infestation of *C. molesta*.

Essig (E. O.). **College Entomology.**—Med. 8vo, vii+900 pp., frontis., 308 figs., many refs. New York, N.Y., MacMillan Co., 1942. Price $5.

Three preliminary chapters (pp. 1–58) of this comprehensive text-book deal with the metamorphosis, anatomy and classification of insects, and each of the remaining 33 is devoted to a separate insect Order. Keys, in some cases illustrated by marginal panel drawings,

are given to the suborders, super-families and families of most, together with information on biology or other points of interest, sometimes under genera or larger groups and sometimes under species. These species are selected as examples because they have a long association with man, exhibit some peculiarity in form, size, colour or habits, or are interesting and typical examples of the family. In a few cases notes are given on the collection and preservation of specimens. Each chapter is followed by a bibliography relating to the Order described in it, and there is also a general bibliography. The book is copiously illustrated, and the main zoogeographical regions of the world are shown in colour on the end-papers.

PEPPER (B. B.). **The Corn Earworm and its Control on Sweet Corn.**—*Circ. N. J. agric. Exp. Sta.* no. 413, 13 pp., 7 figs. New Brunswick, N.J., 1941.

Heliothis armigera, Hb., causes severe injury to sweet maize in New Jersey, where it has two generations and a partial third in the year. The pupae overwinter in the soil, and their survival depends on weather conditions and on the extent to which the soil is disturbed by ploughing, and possibly by the root growth of certain plants. Many survive in the southern part of the State, where there are sandy soils, and much smaller numbers in the north. Adults of the overwintered generation emerge between May and early July, and the early females usually oviposit on the leaves of the maize plant ; when fresh silks become available, most of the eggs are deposited on them. The egg stage lasts 3–7 days, and in summer the larval and pupal stages last 2–3 weeks and 12–18 days, respectively. All the pupae of the third generation, and some of those of the second, overwinter. Infestation is practically continuous throughout the growing season owing to the length of the period over which adults of the overwintered generation emerge and to the migration of adults from southern areas.

The most promising means of protecting maize ears from injury by the larvae is the application of mineral oil containing an insecticide [*cf. R.A.E.*, A **29** 217, etc.], and control is generally profitable when 20 per cent. or more of the ears are infested. The degree of infestation can best be assessed by removing the silks and terminal inch of the husk with a sharp knife from 10 or more ears taken from different parts of the field ; if the larvae have penetrated beyond the cut, brown spots, due to excrement and eaten silks, are visible. In tests with white mineral oils (viscosity 100–300 secs. Saybolt) injected into maize ears, those with the higher viscosities were most effective, but when an insecticide was incorporated, those with viscosities of 100–150 secs. were satisfactory and less costly. Since the addition of an insecticide gives increased effectiveness at very slightly increased cost, the use of oil alone is not recommended. The most effective insecticides for this purpose are pyrethrum extract, which should be added to the oil to give a pyrethrin content of 0·2 per cent., and 2 per cent. dichloroethyl ether. The mixtures should be injected at the rate of $\frac{3}{4}$–1 cc. per ear, and are best applied by means of an apparatus, which is described, consisting of a force oiler of $\frac{1}{4}$–$\frac{1}{2}$ U.S. pint capacity capable of supplying measured amounts of the liquid to each ear, equipped with a long slender spout and connected by a rubber tube to a supply tank carried on the operator's back. For small plantings the tank can be omitted, but the oiler will then need refilling for every 200–300 ears. The oil

should not be applied until the silks have been pollinated, which, under normal conditions, is 2–3 days after they are first exposed ; where an insecticide is included, application may be delayed until about a week after the silks are exposed, thus allowing time for the complete development of the tip kernels, which develop later in some varieties than in others. Only one application is necessary, and the treatment should be completed within three days ; the false ears should be treated as well as the marketable ones, to prevent larvae from migrating from the former to the latter. The best results are obtained with varieties having moderately tight husks and a medium length husk extension.

Notes are given on the two insecticides, and their relative merits are discussed, together with the cost of the treatment ; dichlorocthyl ether is the less expensive and does not deteriorate if the containers are kept tightly closed, but if it is used at low temperatures, such as may occur in late September, a slight odour or flavour may be detected in the maize unless 12–14 days elapse before harvesting.

KASSANIS (B.). **Transmission of Tobacco Etch Viruses by Aphides.**— *Ann. appl. Biol.* **28** no. 3 pp. 238–243, 6 refs. London, 1941.

The results are given of detailed experiments on the relations between the viruses of tobacco etch and their vectors [*cf. R.A.E.*, A **29** 27] in which leaves of medium size, cut from tobacco plants that had been infected for at least 14 days, were used for the infective feeding, and young tobacco seedlings for test plants ; the first symptoms appeared 6–8 days after infection. Severe etch virus [*Marmor erodens* var. *severum* of Holmes] was found to be transmitted by *Myzus circumflexus*, Buckt., *Aphis rhamni*, Boy., *A. fabae*, Scop., and *Macrosiphum solanifolii*, Ashm. (*gei*, auct.) as well as by *Myzus persicae*, Sulz., and although the content of mild etch virus [*M. erodens* var. *vulgare* of Holmes] is much less than that of the severe form, both are transmitted to the same extent by *Myzus persicae*. Preliminary tests showed that there is no delay in the transmission of severe etch, since Aphids fed for two minutes on an infected leaf and transferred immediately to test plants for only two minutes infected them, and that infection could be obtained readily with a single Aphid ; one Aphid per plant was, therefore, used in later experiments. Increasing the preliminary period of starvation increased the percentage of infection of both strains, though this effect disappeared if the period of infective feeding was increased. The longer the Aphids fed on the source of the virus, the less likely they were to transmit it, individuals that had been reared on infected plants and transferred to healthy ones giving a very small percentage of infection. Single Aphids caused most infection when they had not fed for at least four hours and were then fed for only a few minutes on the infected plant, whereas previously starved insects transmitted the virus no better than others when the period of infective feeding was one hour. When the Aphids were kept without food at about 20°C. [68°F.] for various periods between feeding on infected leaves for two minutes and on the test plants, those that had not been subjected to preliminary starving failed to transmit the severe-etch virus after an interval of 15 minutes, and those that had been subjected to preliminary starvation for four hours transmitted it after three hours but not after six. When the temperature between feeds was 3°C. [37·4°F.], however, they transmitted it for three and 24

hours, respectively ; the effect of temperature may possibly explain why the percentage infection is lower under optimum conditions in June–August than under unfavourable conditions in October–December. Aphids that were starved for four hours and fed on infected leaves for two minutes and then on healthy plants for 2–30 minutes before being transferred to the test plants lost most of their infectivity in 15 minutes and all of it in 30 minutes. When each of 30 similarly infected Aphids was fed on four plants in succession for 2–3 minutes and left overnight on a fifth, one infected four plants and two infected three ; seven failed to transmit infection. More cases of infection occurred on the first set of plants, but the total number infected was greater in the last four sets ; in some cases infection was not transmitted until the Aphids had fed on one or more plants. To show that acquiring and losing infection had no effect on future ability to transmit the virus, Aphids were starved for four hours, fed for two minutes on an infective plant and transferred to healthy test plants, on which they were allowed to remain overnight, for two days in succession ; some individuals transmitted the virus on the first day only, some on the second only, and some on both days. When Aphids were subjected to varying periods of preliminary starvation and infective feeding on plants infected with the viruses of both severe etch and tobacco mosaic [*Marmor tabaci* of Holmes] and were then transferred to healthy plants, some transmitted the etch virus but none transmitted the mosaic.

FISHER (R. C.). **Studies of the Biology of the Death-watch Beetle, *Xestobium rufovillosum* DeG. IV. The Effect of Type and Extent of fungal Decay in Timber upon the Rate of Development of the Insect.**—*Ann. appl. Biol.* **28** no. 3 pp. 244–260, 2 graphs, 21 refs. London, 1941.

The following is based on the author's summary of this paper, which deals with investigations in England on the biological aspects of the effect of fungi producing decay of wood on the rate of development of the larvae and the duration of the life-cycle of *Xestobium rufovillosum*, DeG. [*cf. R.A.E.*, A **29** 315]. The minimum duration of the life-cycle at 22–25°C. [71·6–84·2°F.] and 80–90 per cent. relative humidity (equivalent moisture content of wood 18–20 per cent.) was determined in a series of samples representative of a range of different degrees of decay. Loss in oven-dry weight due to fungous attack, expressed as a percentage of the original dry weight of the sound wood, was taken as a measure of the extent of decay. Oak sapwood decayed by *Phellinus cryptarum* (a white rot) and *Coniophora cerebella* (a brown rot), and willow decayed by *Polystictus versicolor* (a white rot), were used. It is shown that sound timber is unsuitable for infestation by first-stage larvae [*cf. loc. cit.*]. In wood decayed by fungi of the brown or white rot types, the rate of boring and development of the larvae increases as the extent of decay increases. The rate of larval development and the duration of the life-cycle are also shown to be affected by changes in density and mechanical strength of timber resulting from fungous attack. These findings are discussed in relation to the published results of the chemical work [**29** 178] ; and the significance of the suggestion that depreciation in mechanical strength is the major effect of fungous decay responsible for the decrease in the duration of the life-cycle associated with an increase in the extent of decay [*cf. loc. cit.*] is examined in relation to the physiology of nutrition of wood-boring

insects. The biological results of the present investigation suggest that sufficient evidence is not available to show that changes in the nutritional value of the wood that might affect the rate of development of the insect do not occur as a result of fungous decay ; and since reconsideration of the chemical data has shown that the nitrogen metabolism of the insect is affected by the presence of fungous decay in timber, it is concluded that the nutritional value of decayed wood in relation to its nitrogen content and distribution is as important as the depreciation in mechanical strength in determining the degree of suitability of timber for infestation by *X. rufovillosum* and the rate of development of the insect in it.

FINNEY (D. J.). **Wireworm Populations and their Effect on Crops.** —*Ann. appl. Biol.* **28** no. 3 pp. 282–295, 1 graph, 3 refs. London, 1941.

In the first part of this paper, methods of estimating the wireworm populations of grass fields with sufficient accuracy and speed to be of service in advisory work are discussed on the basis of records from 500 fields, obtained during the wireworm survey of the 13 agricultural provinces of England and Wales in the 1939–40 harvest year. The results of sample determinations of populations are surveyed. The wireworms found were chiefly the three common species of *Agriotes*, of which *A. obscurus*, L., predominated ; occasional examples of *Athous obscurus*, Payk. (*haemorrhoidalis*, F.) and other species found were included in the counts without comment, as their numbers were too small to have any bearing on the results. The sampling technique is described, and the adequacy of using twenty samples of cylindrical cores, four inches in diameter, to estimate the population of a field is discussed ; the margin of error that may be expected when this technique is applied to grassland is shown in tables. It is considered that the average population of a field is a sufficient guide to its actual condition, since there are few fields in which there is sufficient irregularity in distribution for there to be any question of cropping portions differently, and the number of such fields only slightly exceeds its expectation on an assumption of random distribution.

The use of information obtained on plant population and yield to determine the damage to the first crop after grass to be expected from wireworm populations of different sizes is considered in the second part of the paper, the only crop for which adequate evidence was available being oats. Sample determinations at an early stage of growth showed that the mean plant densities were much lower in the south (920,000 per acre) than in the west (1,230,000) or north (1,310,000); this may have been partly owing to the use of lower seeding rates. The corresponding wireworm populations were 710,000, 366,000 and 218,000 per acre, indicating a progressive decrease from north to south in the plant loss per additional wireworm ; this is probably due to the fact that when the wireworm population is low, most of the plants killed are attacked by one wireworm only, but as the infestation increases, many plants are attacked by two or more, reducing the average rate of plant damage per wireworm. In a more detailed examination of 63 fields in the south, which were subdivided into those with populations above and below 500,000 per acre, the results for fields with the lower infestations agreed very closely with those for the north, whereas the damage per wireworm at the high level of infestation

was very small. Fields in which two counts were made at an interval of 1–4 weeks showed a reduction in plant density of about 20 per cent. during the interval. There was some indication that the loss was greater in the presence of higher infestations, the additional loss per 1,000 wireworms being about 10 plants. It is possible that wireworms had caused the maximum destruction of plants before the first counts were made, though later damage, which continued almost until harvest, might affect the development of the remaining plants. Records for crops of wheat, chiefly autumn-sown, were almost entirely confined to the south. In the south-eastern province, the reduction in stand per additional wireworm in 15 fields agrees with the average for spring-sown oats, suggesting that the crops may have been about equally susceptible to attack. Sampling estimates of yield, obtained from a number of fields, indicated that there was little loss of yield due to wireworm attack at the low infestation levels normally found in the west and north, but there is no reason to suppose that the intensity of wireworm attack on the few fields that were heavily infested was any less than in the south. In the region of high infestations, average yields were low by comparison with the rest of the country, and the effect of changes in the level of infestation on the yield was very considerable, the decrease in yield for each 100,000 additional wireworms per acre being 1·3 cwt. per acre. The average yield of recorded fields was 6 cwt. per acre less in the south than in the north. Analysis of the results supports the view that the sowing of oats in the presence of wireworm populations exceeding 600,000 per acre is an undesirable risk, and that there is still danger in the range from 300,000 to 600,000 per acre. The evidence obtained from 24 estimates of wheat yields in the south indicates that loss of wheat yield by wireworm damage was very similar in extent to that of oats. Examination of the relation between plant density and yield showed that differences in the stand in the south, where plant densities were low, had considerable influence on the resulting yield, whereas in the north, where the plant densities were high, they had little effect.

Evans (J. W.). **Timber Borers.**—*Tasm. J. Agric.* **12** no. 3 pp. 98–100, 3 figs., 2 refs. Hobart, 1941.

Injury to furniture and timber in buildings in Tasmania is commonly caused by *Lyctus brunneus*, Steph., and *Anobium punctatum*, DeG. *Lyctus* attacks partly seasoned and recently seasoned sapwood ; it cannot initiate infestation in well-seasoned timber, though it may continue to develop in it. Almost all commercial Australian hardwoods are liable to attack, but softwoods are immune. *Anobium* infests both sapwood and heartwood of old, well-seasoned timber ; it attacks various kinds of hardwoods and softwoods, but not *Eucalyptus* timber. The eggs of both species are laid in spring and early summer ; the larvae hatch in about three weeks and tunnel in the wood for 8–10 months before pupating near the surface of the wood ; the pupal stage lasts about a month. The life-cycle thus usually requires about a year, but *Anobium* larvae may not reach maturity until the end of a second year.

Control measures comprise brushing or spraying infested timber during spring and early summer, when most of the insects are just below the surface, with suitable insecticides, of which the best is creosote or, if the wood must not be stained, a 5 per cent. solution of

paradichlorobenzene in kerosene [*cf. R.A.E.*, A **23** 202]. Either may be injected into holes in polished furniture with a syringe. The holes may be filled with a stained mixture of beeswax and resin (2 : 1) after treatment.

[Evans (J. W.).] **Cabbage Butterfly.**—*Tasm. J. Agric.* **12** no. 3 p. 109. Hobart, 1941.

The presence of *Pieris rapae*, L., in Tasmania [*cf. R.A.E.*, A **29** 467] has been confirmed by the examination of specimens received in the summer of 1940–41, when the butterflies were numerous in the north of the State, and a few were seen in Hobart.

Waters (H. B.). **Report on the Department of Agriculture (Gold Coast) for the Year 1940–41.**—10 pp. Accra, 1941.

In the section of this report dealing with insect pests of cacao (p. 7), it is recorded that *Bryocoropsis laticollis*, Schum., and *Sahlbergella singularis*, Hagl., increased in numbers with pod development until November, the month of maximum harvest, after which *B. laticollis* decreased, though *S. singularis* continued to increase until January [*cf. R.A.E.*, A **29** 492]. A Reduviid predator that is of importance as a natural enemy of *Sahlbergella* spp. and *B. laticollis* was identified as *Rhynocoris loratus*, Stål. In the section dealing with specialist research (p. 8), a species of *Stictococcus*, attended by the red tree ant, *Oecophylla smaragdina*, F., is recorded on *Pseudospondias microcarpa*, *Celtis* sp. and *Thalia* sp., *Aphis gossypii*, Glov., on imported plants of *Solanum sessiflorum* and *Kalotermes havilandi*, Sjöst., attacking imported beechwood.

Papers noticed by Title only.

[Deev (S. S.).] **Деев (С. С.). A Test of a Control Measure against *Melolontha hippocastani* applying Poisons by Dusting** [experiments with sodium fluosilicate in Voronezh]. [*In Russian.*]—*Bull. Plant Prot.* 1940 no. 3 pp. 67–72, 1 graph, 3 refs. Leningrad, 1940. [For summary see *R.A.E.*, A **29** 571.]

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Regulations for the Enforcement of the Insecticide Act of 1910. Insecticide Act of 1910 (36 Stat. 331 ; 7 U.S.C. 121–134).—*S.R.A., A.M.S.* no. 162, 9 pp. Washington, D.C., U.S. Dep. Agric., 1941.

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